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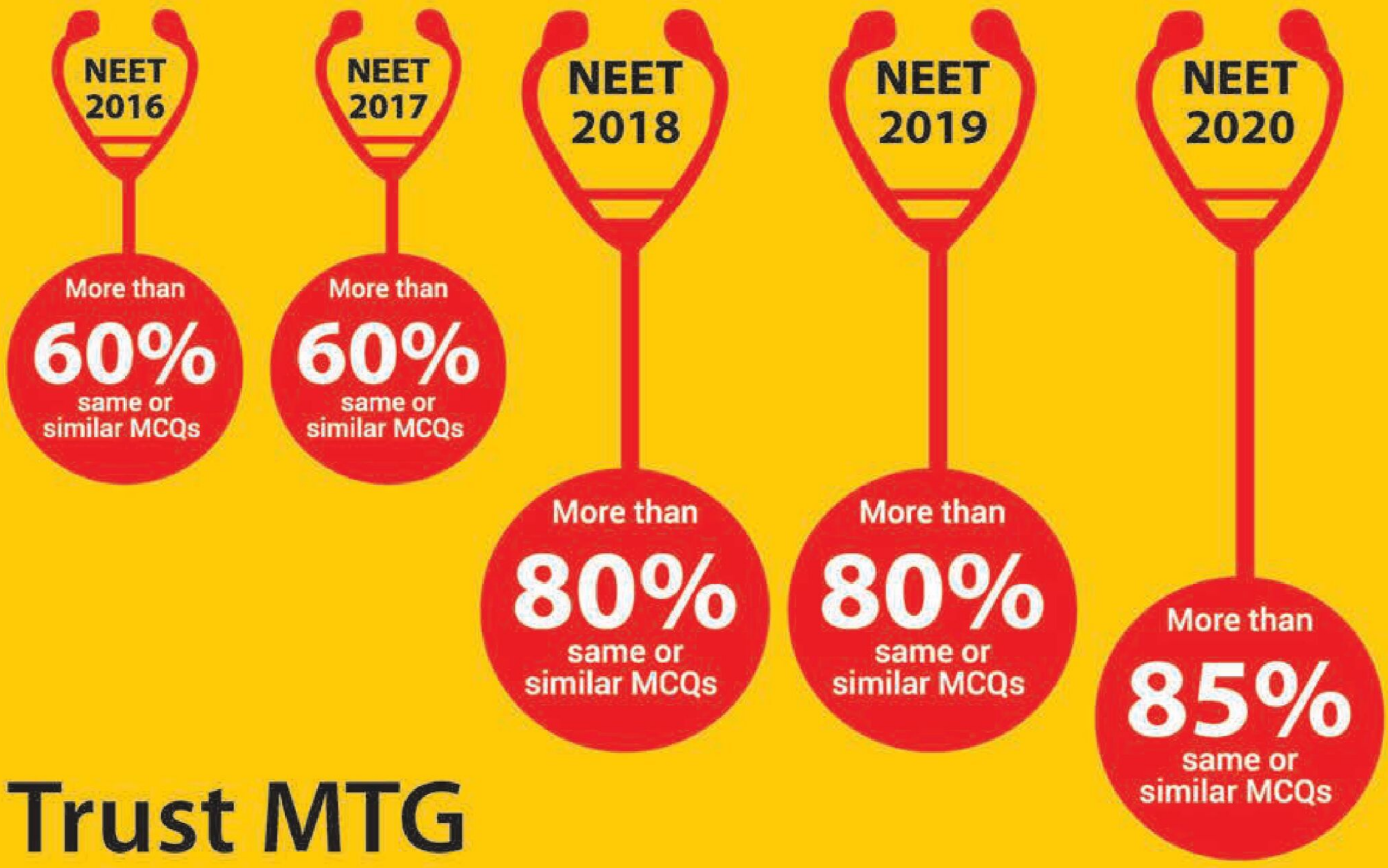

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CHEMISTRY today

Volume 30 No. 6 June 2021

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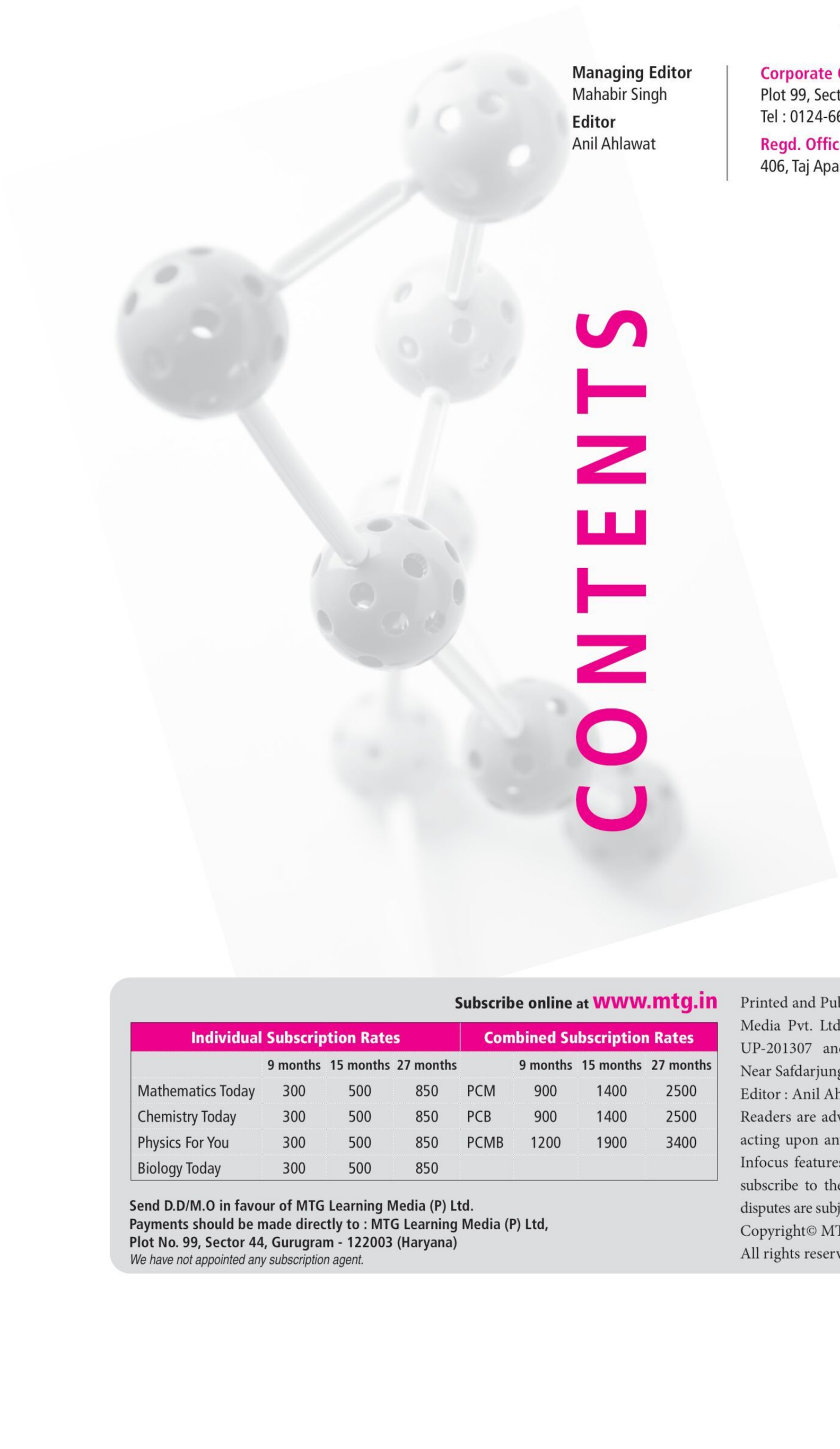

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Printed and Published by Mahabir Singh on behalf of MTG Learning Media Pvt. Ltd. Printed at HT Media Ltd., B-2, Sector-63, Noida, UP-201307 and published at 406, Taj Apartment, Ring Road, Near Safdarjung Hospital, New Delhi - 110029.
Editor : Anil Ahlawat

GEAR UP for JEE MAIN 2021

Section A will be of Multiple Choice Questions (MCQs). Section B will contain questions whose answers are to be filled in as a Numerical Value. In Section B candidates have to attempt any five questions out of 10.

SECTION A (MULTIPLE CHOICE QUESTIONS)

1. Which step is not involved in hydrometallurgical process?

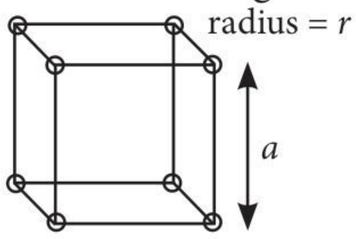
(a) $Cu_2S + 2Cu_2O \longrightarrow 6Cu + SO_2$

(b) $CuFeS_2 + 2H_2SO_4 \longrightarrow CuSO_4 + FeSO_4 + 2H_2S$

(c) $CuSO_4 + Fe \longrightarrow Cu + FeSO_4$

(d) $CuCO_3 + H_2SO_4 \longrightarrow CuSO_4 + H_2O + CO_2$

2. The unit cell in a body centred cubic lattice is given in the figure.



Each sphere has a radius '*r*' and the cube has side '*a*'. What fraction of the total cube volume is empty?

(a) $1-\frac{8}{3}\frac{\pi r^3}{a^3}$ (b) $\frac{8}{3}\frac{\pi r^3}{a^3}$

(c) $\frac{r}{a}$ (d) $2-\frac{4}{3}\frac{\pi r^3}{a^3}$

3. Which of the following phrases are not correctly associated with S_N1 reaction?

I. Rearrangement is possible.

II. Rate is affected by solvent polarity.

III. The strength of the nucleophile is important in rate determining step.

IV. The reactivity order is : tertiary > secondary > primary.

V. Proceeds with complete inversion of configuration.

Select the correct alternate from the following :

(a) III, V only (b) II, III, V only

(c) IV and V only (d) III only

4. An organic liquid has an empirical formula $C_5H_{10}O$. This liquid gives a pale yellow precipitate on warming with iodine in alkaline KI solution. The resulting salt upon acidification gives an acid which easily undergoes decarboxylation on mild heating. The structural formula of the organic liquid could be

(a) $CH_3COCH_2CH_2CH_3$

(b) $H_2C=CH-CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$

(c) $H_3CCH_2CH_2CH_2CHO$

(d) $CH_3-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2CH_3$

5. The pair in which both species have the same magnetic moment (spin only value) is

(a) $[Cr(H_2O)_6]^{2+}$, $[CoCl_4]^{2-}$

(b) $[Cr(H_2O)_6]^{2+}$, $[Fe(H_2O)_6]^{2+}$

(c) $[Mn(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{2+}$

(d) $[CoCl_4)]^{2-}$, $[Fe(H_2O)_6]^{2+}$

6. Consider the following statements.

(i) $Lu(OH)_3$ is the least basic among hydroxides of lanthanides.

(ii) Eu^{2+} is a good reducing agent in solution.

(iii) Lanthanides have high densities.

(iv) Ce^{4+} can act as a reducing agent in solution.

Which of the above is/are true?

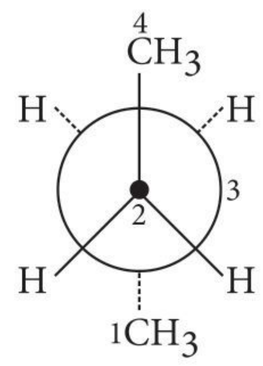
(a) Only (i) and (iv)

(b) Only (i), (ii) and (iii)

(c) Only (iii) and (iv)

(d) Only (iv)

7. In the given conformation, if C_2 is rotated about C_2-C_3 bond anticlockwise by an angle of 120° then the conformation obtained is



(a) fully eclipsed conformation

(b) partially eclipsed conformation

(c) gauche conformation

(d) staggered conformation.

8. Arrange the following ions in the order of decreasing *X*—O bond length, where *X* is the central atom.

(a) ClO_4^-, SO_4^{2-}, PO_4^{3-}, SiO_4^{4-}
(b) SiO_4^{4-}, PO_4^{3-}, SO_4^{2-}, ClO_4^-
(c) SiO_4^{4-}, PO_4^{3-}, ClO_4^-, SO_4^{2-}
(d) SiO_4^{4-}, SO_4^{2-}, PO_4^{3-}, ClO_4^-

9. Time taken for an electron to complete one revolution in the Bohr orbit of hydrogen atom is

(a) $\frac{4\pi^2 mr^2}{nh}$ (b) $\frac{nh}{4\pi^2 mr}$

(c) $\frac{2\pi mr}{n^2h^2}$ (d) $\frac{h}{2\pi mr}$

10. The order of root mean square velocity of H_2, N_2, O_2 and HBr at NTP is

(a) $H_2 > O_2 > N_2 > HBr$
(b) $HBr > H_2 > O_2 > N_2$
(c) $H_2 > N_2 > O_2 > HBr$
(d) $N_2 > O_2 > H_2 > HBr$

11. The disperse phase in colloidal iron(III) hydroxide and colloidal gold is positively and negatively charged respectively. Which of the following is not correct?

(a) Magnesium chloride solution coagulates the gold sol more readily than iron(III) hydroxide sol.
(b) Sodium sulphate solution causes coagulation in both sols.
(c) Mixing of the sols has no effect.
(d) Coagulation in both sols can be brought about by electrophoresis.

12. 20 g of a binary electrolyte (mol. wt. = 100) is dissolved in 500 g of water. The depression in freezing point of the solution is 0.74°C (K_f = 1.86 K molality^{-1}). The degree of the ionisation of the electrolyte is

(a) 0% (b) 100% (c) 75% (d) 50%

13. Consider oxidation of the following alcohols :

I. $CH_2{=}CHCH_2OH \xrightarrow{A} CH_2{=}CHCHO$

II. $(CH_3)_3COH \xrightarrow{B} CH_3\underset{\displaystyle CH_3}{\underset{|}{C}}{=}CH_2$

III. $CH_3CH_2OH \xrightarrow{C} CH_3CO_2H$

IV. $CH_3CH{=}CHCH_3 \xrightarrow{D} CH_3CO_2H$

A, *B*, *C* and *D* are different oxidising agents which are respectively

	A	B	C	D
(a)	MnO_2	Cu/Δ	H_2CrO_4	$KMnO_4/\Delta$
(b)	Cu/Δ	MnO_2	H_2CrO_4	$KMnO_4/\Delta$
(c)	MnO_2	Cu/Δ	$KMnO_4/\Delta$	H_2CrO_4
(d)	MnO_2	H_2CrO_4	Cu/Δ	$KMnO_4$

14. Nitrogen (I) oxide is produced by

(I) thermal decomposition of ammonium nitrate
(II) disproportionation of N_2O_4
(III) thermal decomposition of ammonium nitrite
(IV) interaction of hydroxylamine and nitrous acid

(a) I, II (b) II, III
(c) I, IV (d) II, IV

15. 0.24 g of an organic compound gave 0.22 g CO_2 on complete combustion. If it contains 1.66% hydrogen, then the percentage of C and O will be

(a) 12.5 and 36.6 (b) 25 and 73.4
(c) 25 and 36.6 (d) 25 and 80

16. Consider the ground state configuration of these elements :

$P \rightarrow [He]2p^3$
$Q \rightarrow [He]2p^4$
$R \rightarrow [Ne]3p^5$
$S \rightarrow [Ne]3p^6$

The correct order of electron affinity is

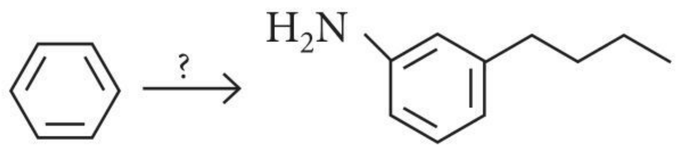
(a) $P > Q > R > S$ (b) $Q > R > P > S$
(c) $R > Q > P > S$ (d) $Q > P > R > S$

17. According to the reduction potentials in the table below, which statement is true under standard conditions?

Reaction	E°(V)
$L^{2+} + 2e^- \longrightarrow L$	–0.13
$M^{2+} + 2e^- \longrightarrow M$	–0.44
$N^{2+} + 2e^- \longrightarrow N$	–0.76

(a) L^{2+} ions oxidize *M* metal.
(b) *M* metal reduces N^{2+} ions.
(c) *M* is a better reducing agent than *N*.
(d) M^{2+} ions are better oxidizing agents then L^{2+} ions.

18. Which of the following reagents used for the given synthesis ?



(a) (i) $C_4H_9Cl + AlCl_3$ (ii) HNO_3 + heat (iii) $ZnCl_2/HCl$
(b) (i) $C_3H_7COCl + AlCl_3$ (ii) HNO_3 + heat (iii) $ZnCl_2/HCl$
(c) (i) HNO_3 + heat (ii) $C_4H_9Cl + AlCl_3$ (iii) $ZnCl_2/HCl$
(d) (i) HNO_3 + heat (ii) $C_3H_7COCl + AlCl_3$ (iii) $ZnCl_2/HCl$

19. Among the following compound which one is both paramagnetic and coloured?

(a) $K_2Cr_2O_7$ (b) $(NH_4)_2[TiCl_6]$

(c) $VOSO_4$ (d) $K_3[Cu(CN)_4]$

20. Which of the following is an incorrect statement?

(a) Non-ionic detergents are neutral.

(b) The hydrophilic portion of a non-ionic detergent functions by a hydrogen bonding mechanism.

(c) Cationic detergents have a positively charged water soluble portion.

(d) LABS detergent are not biodegradable.

SECTION B (NUMERICAL VALUE TYPE)

21. What is the concentration of aqueous ammonia solution prepared by dissolving 0.15 mole of $CH_3COO^-NH_4^+$ in 1 L H_2O?

$[K_{a(CH_3COOH)} = 1.8 \times 10^{-5} = K_{b(NH_3)}]$

22. Volume of N_2 at NTP required to form a monolayer on the surface of iron catalyst is 8.15 mL/g of the adsorbent. What will be the surface area of the 100 g adsorbent if each nitrogen molecule occupies 16×10^{-22} m^2?

23. Water and chlorobenzene are immiscible liquids. Their mixture boils at 90 °C under a reduced pressure of 7.82×10^4 Pa. The vapour pressure of pure water at 90 °C is 7.03×10^4 Pa. On weight per cent basis, chlorobenzene in the distillate is equal to (mol. wt. of chlorobenzene is 112.5 g mol^{-1})

24. From the following data, the enthalpy change for the sublimation of ice at 223 K will be _____.

(Given : mean heat capacity of ice = 2 J K^{-1} g^{-1}, mean heat capacity of $H_2O_{(l)}$ = 4.2 J K^{-1} g^{-1}, mean heat capacity of $H_2O_{(g)}$ = 1.85 J K^{-1} g^{-1}, enthalpy of fusion of ice at 0°C = 334 J g^{-1}, enthalpy of evaporation of water at 100°C = 2255 J g^{-1})

25. The dipole moment of HBr is 0.78×10^{-18} esu cm and interatomic spacing is 1.41 Å. The % ionic character of HBr is _____.

26. In a reaction which is carried out at 400 K, 0.0001% of the total number of collisions are effective. The energy of activation of the reaction is _____.

27. The threshold wavelength of photoelectric effect of a metal is 230 nm. The kinetic energy of the photoelectron ejected from the surface by UV radiation emitted from the second longest wavelength for the downward transition of electron in Lyman series of the atomic spectrum of hydrogen ($R = 1.096 \times 10^7$ m^{-1}) will be _____.

28. Equilibrium constant for the reaction in terms of log K is _____.

$2Fe^{3+} + 3I^- \rightleftharpoons 2Fe^{2+} + I_3^-$

Given, $Fe^{3+} + e^- \longrightarrow Fe^{2+}$; $E^\circ = 0.76$ V

$\frac{1}{2} I_2 + e^- \longrightarrow I^-$; $E^\circ = 0.53$ V

29. The amount of heat evolved when 500 cm^3 of 0.1 M HCl is mixed with 200 cm^3 of 0.2 M NaOH is _____.

30. In a Duma's nitrogen estimation, 0.3 g of an organic compound gave 50 mL of nitrogen collected at 300 K and 715 mm pressure. Calculate the percentage of nitrogen in the compound (vapour pressure of water at 300 K is 15 mm).

SOLUTIONS

1. **(a)**

2. **(a) :** Fraction of occupied space

$$= \frac{\text{Occupied volume}}{\text{Total volume}} = \frac{8}{3}\frac{\pi r^3}{a^3}$$

$$\text{Fraction of empty space} = 1 - \frac{8}{3}\frac{\pi r^3}{a^3}$$

3. **(a)**

4. **(b) :** $H_2C=CH-CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3 + I_2 \xrightarrow[KI]{OH^-}$

$CHI_3\downarrow + H_2C=CH-\underset{(A)}{CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-O^-} \xrightarrow[(-CO_2)]{H^+/\Delta} H_2C=CH-CH_3$

Yellow ppt.

Acid (*A*) is β,γ-unsaturated acid easily undergoes decarboxylation, due to the stabilization of carbanion.

$H_2C=CH-\bar{C}H_2 \longleftrightarrow H_2\bar{C}-CH=CH_2$

5. **(b) :** $[Cr(H_2O)_6]^{2+} = Cr^{2+}$; $3d^4$ = four unpaired electrons

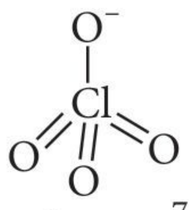
$[Fe(H_2O)_6]^{2+} = Fe^{2+} = 3d^6$; four unpaired electrons

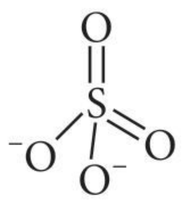
Hence, both the species have same magnetic moment.

6. **(b) :** Ce^{4+} acts as a good oxidising agent.

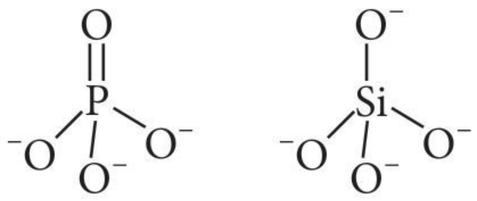
7. **(c)**

8. **(b) :**





Bond order : $\frac{7}{4} = 1.75$ $\frac{6}{4} = 1.5$



Bond order : $\frac{5}{4}=1.25$ $\frac{4}{4}=1$

Greater the bond order, shorter is the bond length.

Hence, X — O bond length will decrease in the order :

$SiO_4^{4-} > PO_4^{3-} > SO_4^{2-} > ClO_4^-$

9. (a) : By Bohr's postulate,

$$mvr = n\frac{h}{2\pi} \quad \text{or,} \quad v = \frac{nh}{2\pi mr}$$

No. of revolutions per second

$$= \frac{\text{velocity}}{\text{circumference of the orbit}}$$

$$= \frac{v}{2\pi r} = \frac{nh}{2\pi mr} \times \frac{1}{2\pi r} = \frac{nh}{4\pi^2 mr^2}$$

$\therefore$ Time taken for one revolution $= \frac{4\pi^2 mr^2}{nh}$

10. (c) : Root mean square velocity $= \sqrt{\frac{3RT}{M}}$

Since, $M_{HBr} > M_{O_2} > M_{N_2} > M_{H_2}$

$\therefore$ The order of *rms* velocity for the given gases is :

$H_2 > N_2 > O_2 > HBr$

11. (c) : When positive and negative sols are mixed, they coagulate each other.

12. (a) : $\Delta T_f = \frac{1000 \times K_f \times W_2}{M_2 \times 500}$

$$\Rightarrow \quad 0.74 = \frac{1000 \times 1.86 \times 20}{M_2 \times 500} \quad \Rightarrow M_2 = 100$$

Actual molecular mass = 100

$$i = \frac{100}{100} = 1 + \alpha \quad \Rightarrow \alpha = 0$$

$\therefore$ The degree of ionisation of the electrolyte is 0%.

13. (a)

14. (c) : $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

$NH_2OH + HNO_2 \xrightarrow{aq.} N_2O + 2H_2O$

In thermal decomposition of ammonium nitrite, N_2 is produced.

$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

N_2O_4 disproportionates into NO_2^- and NO_3^-.

15. (b) : % of $C = \frac{12}{44} \times \frac{\text{Mass of } CO_2}{\text{Mass of substance}} \times 100$

$$= \frac{12 \times 0.22}{44 \times 0.24} \times 100 = 25; \ C = 25, \ H = 1.66$$

Total % of C and H = 26.6

% of O = 100 – 26.6 = 73.4

16. (c) : Here, the correct order can be given as $R > Q > P > S$.

17. (a) : $E°$cell for the reaction :

$L^{2+} + M \longrightarrow M^{2+} + L$

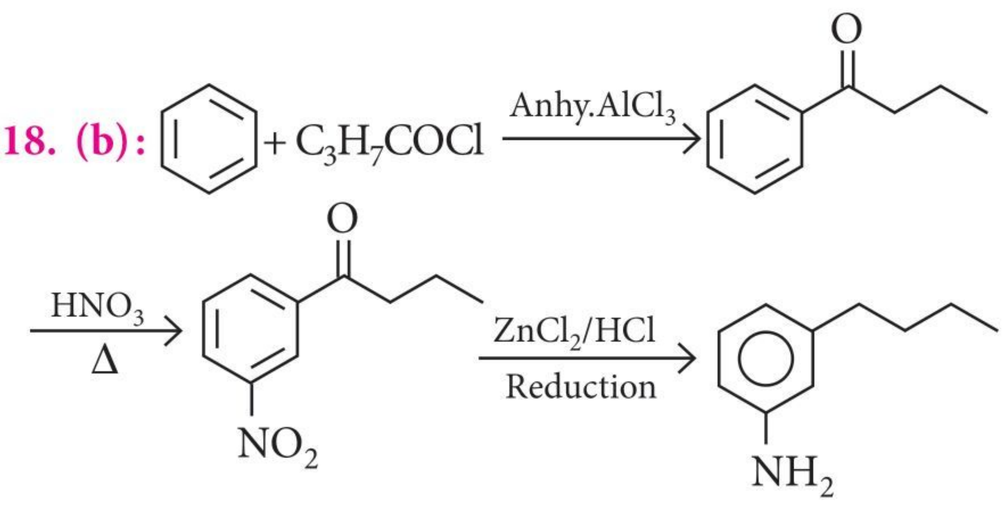
$E°_{cell} = +0.44 - 0.13 > 0$

$M + N^{2+} \longrightarrow M^{2+} + N$

$E°_{cell} = +0.44 - 0.76 = -0.36 \text{ V} < 0$

So, metal M cannot reduce N^{2+} ions.

18. (b) :



19. (c) : The oxidation state of vanadium in $VOSO_4$ is +4.

$V(Z = 23) = [Ar]3d^3 4s^2$

$V^{4+}(Z = 23) = [Ar]3d^1 4s^0$

It has one unpaired electron hence, it is coloured and paramagnetic in nature.

20. (d) : All LABS detergents are not biodegradable and some of them cause pollution and are hazaradous to human civilization.

21. (8.3×10^{-4}) :

$$CH_3COONH_4 + H_2O \rightleftharpoons \underset{c(1-h)}{CH_3COOH} + \underset{ch}{NH_4OH} \quad \underset{ch}{}$$

$$\sqrt{\frac{k_w}{k_a \times k_b}} = \frac{h}{1-h} \Rightarrow \frac{10^{-2}}{1.8} = \frac{h}{1-h} \approx h = 5.55 \times 10^{-3}$$

$[NH_4OH] = ch = 0.15 \times 5.55 \times 10^{-3} = 8.3 \times 10^{-4}$

22. (35) : Total volume of N_2 occupying 100 g adsorbent = 8.15 × 100 mL = 815 mL

$$\text{Mole of } N_2 = \frac{815}{22400} = 0.036$$

$\therefore$ No. of molecules of N_2

$= 0.036 \times 6.022 \times 10^{23} = 2.17 \times 10^{22}$

$\therefore$ Required surface area

$= 2.17 \times 10^{22} \times 16 \times 10^{-22} \approx 35 \text{ m}^2$

23. (70) : $pV = nRT$

$p_{mix} = 7.82 \times 10^4$ Pa

$p_1 + p_2 = 7.82 \times 10^4$ Pa

$p_1 = 7.03 \times 10^4$ Pa $\therefore \quad p_2 = 0.79 \times 10^4$ Pa

$$p \propto n \propto \frac{w}{m}, \quad \therefore \quad \frac{w_2 m_1}{w_1 m_2} = \frac{p_2}{p_1}$$

$$\frac{w_2}{w_1} = \frac{p_2 m_2}{p_1 m_1} = \frac{(0.79 \times 10^4) \times 112.5}{(7.03 \times 10^4) \times 18} = 0.70$$

Weight per cent of chlorobenzene in distillate

$= 0.70 \times 100 = 70$

24. (2831.5) :

$$\begin{array}{ccc} H_2O_{(s)} & \longrightarrow & H_2O_{(g)} \\ (223\ K) & & (223\ K) \\ \downarrow & & \uparrow \\ H_2O_{(s)} & & H_2O_{(g)} \\ (273\ K) & & (373\ K) \\ \downarrow & & \uparrow \\ H_2O_{(l)} & \longrightarrow & H_2O_{(l)} \\ (273\ K) & & (373\ K) \end{array}$$

$\Delta H_{\text{sub.(at 223 K)}} = C_{p(\text{ice})}\,(273 - 223) + \Delta H_{\text{fusion}}$

$+ C_{p(\text{water})}\,(373 - 273) + \Delta H_{\text{vap}} + C_{p(\text{vapour})}\,(223 - 373)$

$= 2 \times 50 + 334 + 4.2 \times 100 + 2255 + 1.85\,(-150) = 2831.5$

25. (11.5) : Dipole moment of HBr (when 100% ionic)

$= 4{\cdot}8 \times 10^{-10} \times 1{\cdot}41 \times 10^{-8}$ cm

$= 6{\cdot}768 \times 10^{-18}$ esu cm

Actual dipole moment $= 0{\cdot}78 \times 10^{-18}$ esu cm

$\therefore$ % ionic character

$$= \frac{0{\cdot}78 \times 10^{-18}}{6{\cdot}768 \times 10^{-18}} \times 100 = 11{\cdot}52 \approx 11.5$$

26. (11.05) : $f = e^{-E_a/RT}$

$$\ln \frac{1}{f} = \frac{E_a}{RT} \Rightarrow \ln \frac{1}{0.0001 \times \frac{1}{100}} = \frac{E_a}{2 \times 400}$$

$E_a = 11.05$ kcal/mol

27. (19.3×10^{-19}) : Minimum energy required to eject an electron

$$E_0 = h\nu_0 = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{230 \times 10^{-9}} = 8.6 \times 10^{-19}\ \text{J}$$

For spectral lines of the Lyman series of H-atom

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{n_2^2}\right)$$

For second longest wavelength, $n_2 = 3$.

$$\frac{1}{\lambda} = 1.096 \times 10^7 \left(1 - \frac{1}{9}\right) = 1.096 \times 10^7 \times \frac{8}{9} = 9.74 \times 10^6$$

Energy of photon of this wavelength

$$E = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1.026 \times 10^{-7}} = 19.3 \times 10^{-19}\ \text{J}$$

$K.E. = E_{\text{incident}} - E_{\text{threshold}}$

$= (19.3 \times 10^{-19}) - (8.6 \times 10^{-19}) = 1.07 \times 10^{-18}$ J

28. (7.78) : $2 \times [Fe^{3+} + e^- \longrightarrow Fe^{2+}]$ $E^\circ_{\text{cell}} = 0.76$ V

$2I^- \longrightarrow I_2 + 2e^-$; $E^\circ = -0.53$ V

$I_2 + I^- \rightleftharpoons I_3^-$

$2Fe^{3+} + 3I^- \rightleftharpoons 2Fe^{2+} + I_3^-$; $E^\circ_{\text{cell}} = 0.23$ V

$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.0591}{2} \log K_{\text{eq}}$$

$\because \quad E_{\text{cell}} = 0.0$ V at equilibrium,

$$\therefore \quad E^\circ_{\text{cell}} = \frac{0.0591}{2} \log K_{\text{eq}} \quad \text{or} \quad \frac{0.23 \times 2}{0.0591} = \log K_{\text{eq}}$$

$\log K_{\text{eq}} = 7.78$

29. (2.284) : Milliequivalents of HCl $= 500 \times 0.1$

$= 50$ millimoles $= 0.05$ moles

Milliequivalents of NaOH $= 200 \times 0.2$

$= 40$ millimoles $= 0.04$ moles

1 gram equivalent of NaOH liberats 57.1 kJ.

$\therefore$ 0.04 g equivalent of NaOH on neutralization will liberats

$= 0.04 \times 57.1 = 2.284$ kJ

30. (17.46) : Vapour pressure of gas $= 715 - 15$

$= 700$ mm

To calculate the volume of N_2 at S.T.P.

$p_1 = 700$ mm $\qquad p_2 = 760$ mm

$V_1 = 50$ mL $\qquad V_2 = ?$

$T_1 = 300$ K $\qquad T_2 = 273$ K

Applying $\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$ or $V_2 = \frac{p_1 V_1 T_2}{p_2 T_1}$

$$\therefore \quad V_2 = \frac{700 \times 50 \times 273}{760 \times 300} = 41.9\ \text{mL}$$

22400 mL of nitrogen at S.T.P. weigh $= 28$ g

$\therefore$ 41.9 mL of nitrogen at S.T.P. weigh $= \frac{28 \times 41.9}{22400}$

$= 0.0524$ g

Percentage of nitrogen $= \frac{0.0524}{0.3} \times 100 = 17.46\%$

JEE 2021 PRACTICE PAPER ADVANCED

PAPER - I

Section 1 (Maximum Marks : 18)

- *This section contains SIX (06) questions.*
- *Each question has FOUR options. ONLY ONE of these four options is the correct answer.*
- *For each question, choose the option corresponding to the correct answer.*
- *Answer to each question will be evaluated according to the following marking scheme :*

Full Marks :	*+3*	*If ONLY the correct option is chosen.*
Zero Marks :	*0*	*If none of the options is chosen (i.e. the question is unanswered).*
Negative Marks :	*–1*	*In all other cases.*

1. Which of the following substrates will give rearranged product in hydration reaction?

(a) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH=CH_2$

(b) $CH_3-\ddot{\underset{\displaystyle \ddot{}}{S}}-CH_2-CH=CH_2$

(c) $CH_3-CH=CH_2$

(d) $\begin{matrix} Ph \\ Ph \end{matrix}\!\!\diagdown\!\!C=CH-\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_3$ (with CH_3 above the C)

2. Which of the following statements is/are incorrect?

(a) Cassiterite, chromite and pitchblende are concentrated by hydraulic washing (Tabling)

(b) Pure Al_2O_3 is obtained from the bauxite ore by leaching in the Baeyer's process

(c) Sulphide ore is concentrated by calcination method

(d) Roasting can convert sulphide into oxide or sulphate and part of sulphide may also act as a reducing agent

3. Devise a series of reactions to convert ethyl 3-oxobutanoate to ethyl 4-oxopentanoate.

Select reagents and conditions from the following table, listing them in the order of use :

(1) Sodium ethoxide in ethanol

(2) Ethanol + Acid catalyst

(3) H_3O^+; heat (4) CO_2 then H_3O^+

(5) Mg in ether (6) PBr_3

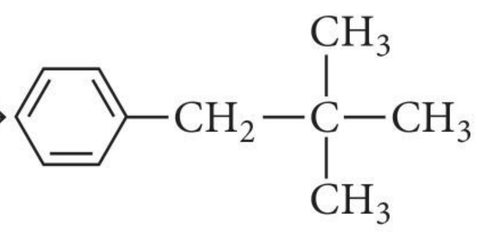
(7) $NaBH_4$ in alcohol (8) CH_2I_2 in ether; Zn – Cu

(9) $BrCH_2COOC_2H_5$ (10) $(CH_3CO)_2O$; Pyridine

(a) 1, 9, 3 then 2 (b) 7, 6, 5, 10 then 2

(c) 3, 7, 6, 5, 10 then 2 (d) 8, 3 then 2

4. Which set of reactants *A* and *B* should be used to get best yield of given product?

$A + B \xrightarrow{\text{Ether}}$ 

(a) PhLi and neopentyl chloride

(b) *t*-BuMgBr and benzyl bromide

(c) PhMgBr and neopentyl bromide

(d) Benzylchloride and *t*-butyl chloride

5. FeO crystal has a simple cubic structure and each edge of the unit cell is 5 Å. Taking density of the oxide as 4 g/cc, the number of Fe^{2+} and O^{2-} ions present in each unit cell are

(a) $4Fe^{2+}$ and $4O^{2-}$ (b) $6Fe^{2+}$ and $6O^{2-}$

(c) $2Fe^{2+}$ and $2O^{2-}$ (d) $1Fe^{2+}$ and $1O^{2-}$

6. The bond angle between two hybrid orbitals is 180°. The percentage *s*-character of hybrid orbital is

(a) 50 (b) 75

(c) 33 (d) 66

Section 2 (Maximum Marks : 24)

- *This section contains SIX (06) questions.*
- *Each question has FOUR options. ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).*

- ***For each question, choose the option(s) corresponding to (all) the correct answer(s).***
- ***Answer to each question will be evaluated according to the following marking scheme :***

Full Marks :	***+4***	***If only (all) the correct option(s) is (are) chosen.***
Partial Marks :	***+3***	***If all the four options are correct but ONLY three options are chosen.***
Partial Marks :	***+2***	***If three or more options are correct but ONLY two options are chosen, both of which are correct.***
Partial Marks :	***+1***	***If two or more options are correct but ONLY one option is chosen and it is a correct option.***
Zero Marks :	***0***	***If none of the options is chosen (i.e. the question is unanswered).***
Negative Marks :	***–2***	***In all other cases.***

7. In the following reactions,

I. $FeSO_4 + NO + H_2O \rightarrow X$

II. Sodium nitroprusside + $Na_2S \rightarrow Y$

Which of the following statement(s) is (are) correct?

(a) Products X and Y both are paramagnetic.

(b) In the reaction I change of oxidation state of central atom occurs while in reaction (II) there is no change in oxidation state.

(c) X is brown and Y is violet in colour.

(d) Magnetic moment of compound X is $\sqrt{15}$.

8. From the following data, mark the option(s) where ΔH is correctly written for the given reaction.

Given : $H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$; $\Delta H = -57.3$ kJ/mol

$\Delta H_{solution}$ of $HA_{(g)} = -70.7$ kJ/mol

$\Delta H_{solution}$ of $BOH_{(g)} = 20$ kJ/mol

$\Delta H_{ionisation}$ of HA = 15 kJ/mol and BOH is a strong base.

Reaction	**$\Delta_r H$(kJ/mol)**
(a) $HA_{(aq)} + BOH_{(aq)} \longrightarrow BA_{(aq)} + H_2O$	–42.3
(b) $HA_{(g)} + BOH_{(g)} \longrightarrow BA_{(aq)} + H_2O$	–93
(c) $HA_{(g)} \longrightarrow H^+_{(aq)} + A^-_{(aq)}$	–55.7
(d) $BOH_{(g)} \longrightarrow B^+_{(aq)} + OH^-_{(aq)}$	–20

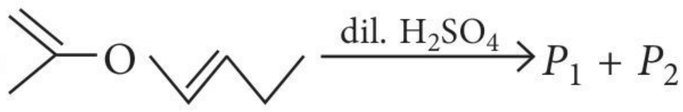
9. Successive ionization energies (in kJ/mol) of element A are given below :

$I.E._1$	$I.E._2$	$I.E._3$
520	7300	12000

If A reacts with different elements, which compound(s) is/are possible ?

(a) AF (b) A_2O

(c) A_3N (d) A_3N_2

10. 

P_1 and P_2 products are identified by

(a) Tollens' reagent (b) Iodoform test

(c) $Br_2 + H_2O$ test (d) 1% of alkaline $KMnO_4$.

11. In which of the following option(s) all species contains X — O — X bond(s) in the structure?

(X = central atom)

(a) $H_2S_2O_6$, S_3O_9, $S_2O_6^{2-}$

(b) P_4O_{10}, P_4O_6, $H_5P_3O_{10}$

(c) N_2O_5, N_2O, N_2O_4

(d) S_3O_9, P_4O_6, $Si_2O_7^{6-}$

12. Which of the following statements is/are correct?

(a) Alcoholic group is tested by CAN test.

(b) Accurate method to determine the molecular weight of organic compound is 'cryoscopic method'.

(c) If there is 54% silver in a silver salt of a dibasic acid, then its (dibasic acid) molar mass is 186 g mol^{-1}.

(d) Diazonium salts form azo dyes with alkaline compounds.

Section 3 (Maximum Marks : 24)

- ***This section contains SIX (06) questions. The answer to each question is a NUMERICAL VALUE.***
- ***For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.***
- ***Answer to each question will be evaluated according to the following marking scheme :***

Full Marks :	***+4***	***If ONLY the correct numerical value is entered.***
Zero Marks :	***0***	***In all other cases.***

13. The wavelength of photoelectric threshold of a metal is 230 nm. The $K.E.$ (in Joule) of the photoelectron ejected from the surface by U.V. radiation emitted from the 2nd longest wavelength transition of electron in Lyman series of atomic spectrum of hydrogen is _____.

($R = 1.09677 \times 10^7$ m^{-1})

14. The dissociation constant of a weak acid is 1.6×10^{-5} and the molar conductivity at infinite dilution is 380×10^{-4} S m^2 mol^{-1}. If the cell constant is 0.01 m^{-1} then conductance (in S) of 0.01 M acid solution is_____.

15. The ionisation constant of benzoic acid is 6.46×10^{-5} and K_{sp} for silver benzoate is 2.5×10^{-13}. Silver benzoate is _____ times more soluble in a buffer of pH 3.19 as compared to pure water.

16. A certain dye absorbs light of $\lambda = 4530$ Å and then fluorescence light of 5080 Å. Assuming that under given conditions 47% of the absorbed energy is re-emitted out as fluorescence, calculate the ratio of quanta emitted out to the no. of quanta absorbed.

17. To a 10 mL, 1 M aqueous solution of Br_2, excess of NaOH is added so that all Br_2 is disproportionated to Br^- and BrO_3^-. The resulting solution is free from Br^- and excess of OH^- is neutralised by acidifying the solution. The resulting solution is sufficient to react with 2 g of impure CaC_2O_4 (M = 128 g/mol) sample. The % purity of oxalate sample is

18. A first order reaction $A \rightarrow B$, requires activation energy of 70 kJ mol^{-1}. When a 20% solution of A was kept at 25°C for 20 minutes, 25% decomposition took place. The per cent decomposition in same time of a 30% solution maintained at 40°C is _____. (Assume that activation energy remains constant in this range of temperature.)

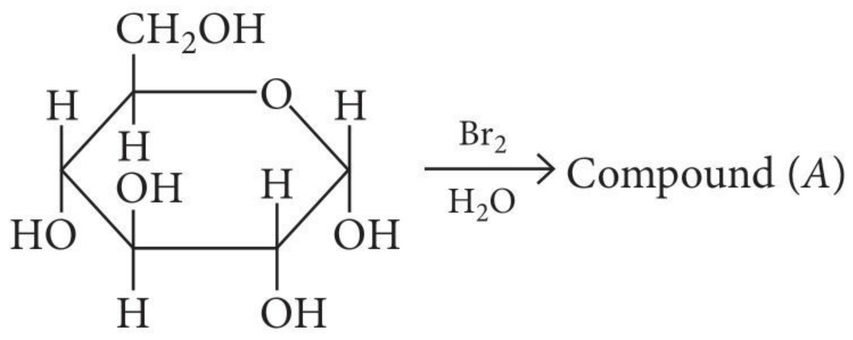
PAPER - II

Section 1 (Maximum Marks : 18)

- ***This section contains SIX (06) questions.***
- ***The answer to each question is a SINGLE DIGIT INTEGER ranging from 0 to 9, BOTH INCLUSIVE.***
- ***For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.***
- ***Answer to each question will be evaluated according to the following marking scheme :***

Full Marks :	***+3***	***If ONLY the correct integer is entered.***
Zero Marks :	***0***	***If the question is unanswered;***
Negative Marks :	***–1***	***In all other cases.***

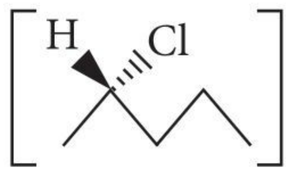
1. Number of chiral centre in compound A is _____.

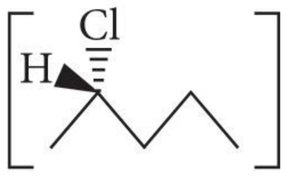


2. 5.26 g mixture of ethanol and acetaldehyde when heated with Fehling's solution gave 1.2 g of a red ppt. The percentage of acetaldehyde in the mixture is _____ .

3. A complex of Fe^{2+} has magnetic moment value of 4.89 B.M. The number of electrons in the t_{2g} level of Fe^{2+} is_____.

4. When (*S*)-2-chloropentane reacts with NaOH in 75 per cent ethanol and 25 per cent acetone follows rate law :

$$\text{Rate} = 2.35 \times 10^{-5} \left[\text{  } \right] [OH^-] +$$

$$3.0 \times 10^{-6} \left[\text{  } \right]$$

What will be percentage of S_N1 product when concentration of $[OH^-]$ = 1.5 molar?

5. An aromatic hydrocarbon (A) $C_{16}H_{16}$ shows following reactions :

(i) It decolourizes both Br_2 in CCl_4 and cold aq. $KMnO_4$.

(ii) It adds an equimolar amount of H_2.

(iii) Oxidation with $KMnO_4$ gives a dicarboxylic acid (B) $C_6H_4(COOH)_2$ which gives only one monobromo substitution product.

The number of stereoisomers of the compound (A) is_____.

6. If edge fraction unoccupied in ideal anti-fluorite structure is x. Calculate the value of Z $\left(\text{where, } Z = \frac{x}{0.097} \right)$.

Section 2 (Maximum Marks : 24)

- ***This section contains SIX (06) questions.***
- ***Each question has FOUR options. ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).***
- ***For each question, choose the option(s) corresponding to (all) the correct answer(s).***
- ***Answer to each will be evaluated according to the following marking scheme :***

Full Marks :	***+4***	***If only (all) the correct option(s) is (are) chosen;***

Partial Marks : **+3** ***If all the four options are correct but ONLY three options are chosen;***

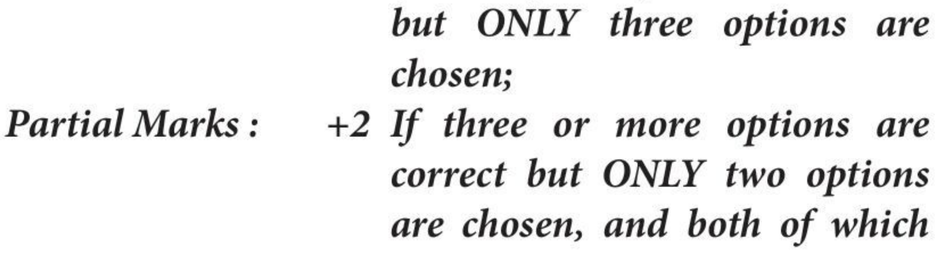
Partial Marks : **+2** ***If three or more options are correct but ONLY two options are chosen, and both of which are correct;***

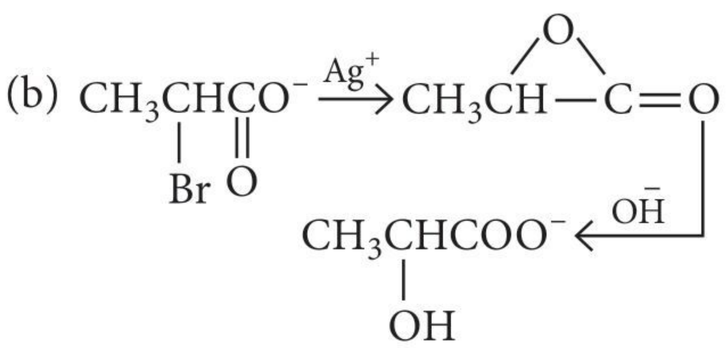
Partial Marks : **+1** ***If two or more options are correct but ONLY one option is chosen and it is a correct option;***

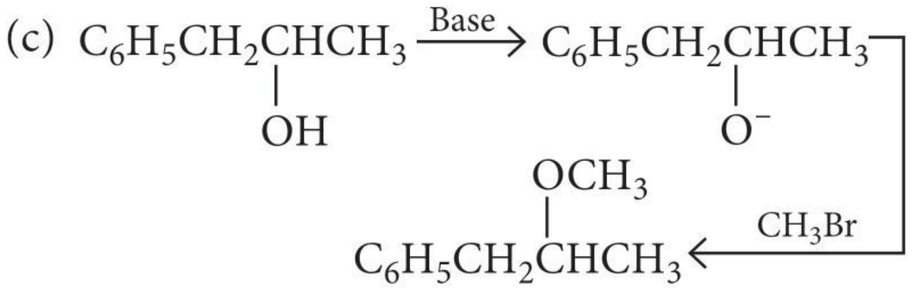
Zero Marks : **0** ***If none of the options is chosen (i.e., the question is unanswered);***

Negative Marks : **–2** ***In all other cases.***

7. In which of the following reaction(s), complete inversion takes place?

(a) 

(b) 

(c) 

(d) $C_6H_5CH_2CH_2CH_2OTs \xrightarrow{C_2H_5O^-} C_6H_5CH_2CH_2CH_2OC_2H_5$

8. Which relation is/are not correct for an aqueous dilute solution of K_3PO_4 if its degree of dissociation is α?

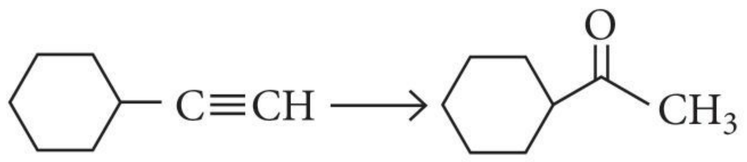
(a) $\dfrac{\Delta P}{P^\circ} = \dfrac{\text{Molality} \times 18 \times (1+3\alpha)}{1000}$

(b) $\dfrac{\Delta P}{P^\circ} = \dfrac{\pi_{obs} \times 18 \times (1+3\alpha)}{RT \times 1000}$

(c) $\dfrac{\Delta P}{P^\circ} = \dfrac{\Delta T_{f\,(obs)} \times 18}{K_f \times 1000}$

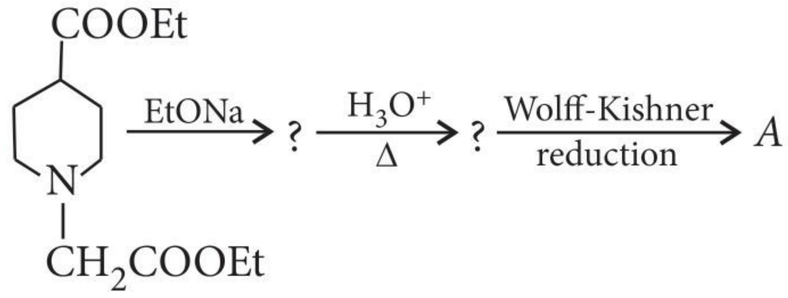
(d) M_w of $K_3PO_4 = M_{w(obs)} \times (1 + 3\alpha)$

9. The reagents used to convert

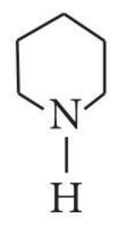


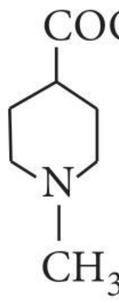
are

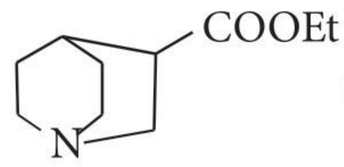
	(I)	(II)	(III)
(a)	O_3/Reduction	$Al_2(CO_3)_3$	MeCOOH
(b)	$H_2SO_4 + HgSO_4$	H_2O	heat
(c)	O_3/Zn – AcOH	$H_2SO_4 + HgSO_4$	H_2O, heat
(d)	CH_3COOH	H_2O_2	OH^-/H_2O

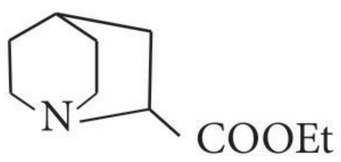
10. 

The final product (*A*) in the reaction is

(a) 

(b) 

(c) 

(d) 

11. Consider the following steps:

$Cu_2S \xrightarrow{\text{Roast in air}} A \xrightarrow{\text{Heating without air}} B$

Which is not the correct statement?

(a) It involves self-reduction.

(b) *A* is only Cu_2O and *B* is a mixture of Cu and SO_3.

(c) *A* is mixture of Cu_2O and Cu_2S and *B* is a mixture of Cu and SO_2.

(d) The solidified copper obtained has blistered appearance.

12. A powdered substance (*A*) on treatment with fusion mixture gives a green coloured compound (*B*). The compound (*B*) on acidification with dilute H_2SO_4 gives a pink coloured compound (*C*). When (*A*) is treated with excess of NaOH and bromine water, (*D*) is obtained. Solution of (*A*) in dilute HCl on treatment with a solution of barium chloride gave a white precipitate of (*E*), which was insoluble in conc. HNO_3 and conc. HCl.

Then, which of the following is/are correct?

(a) *B* is Na_2MnO_4 (b) *E* is $MnSO_4$

(c) *D* is MnO_2 (d) *C* is $NaMnO_4$

Section 3 (Maximum Marks : 24)

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- ***For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks :	***+4***	***If ONLY the correct numerical value is entered;***
Zero Marks :	***0***	***In all other cases.***

13. When 3.06 g of solid NH_4HS is introduced into a two litre evacuated flask at 27°C, 30% of the solid decomposes into gaseous ammonia and hydrogen sulphide. K_p for the reaction at 27°C is_____.

14. If it is desired to construct the following voltaic cell to have E_{cell} = 0.0860 V. Then $[Cl^-]$ concentration that must be present in the cathodic half cell to achieve the desired emf is _____.
$Ag_{(s)} \mid Ag^+$ (Sat. $AgI_{(aq.)}$) $\| Ag^+$ (Sat. AgCl.$xM Cl^-$) $\mid Ag_{(s)}$
(Given K_{sp} of AgCl and AgI are 1.8×10^{-10} and 8.5×10^{-17} respectively.)

15. 0.4 g of an organic compound was Kjeldahlised and ammonia evolved was absorbed into 50 mL of *N*/2 H_2SO_4. The residual acid solution was diluted with water to make the volume 150 mL. 20 mL of this solution required 31 mL of *N*/20 NaOH solution for complete neutralization. The percentage of nitrogen in the compound is

16. 1 mole of an ideal gas $A(C_{v,m} = 3R)$ and 2 mole of an ideal gas *B* are $\left(C_{v,m} = \frac{3}{2}R\right)$ taken in a container and expanded reversible and adiabatically from 1 litre to 4 litre starting from initial temperature of 320 K. ΔE or ΔU (in Joules) for the process is _____.

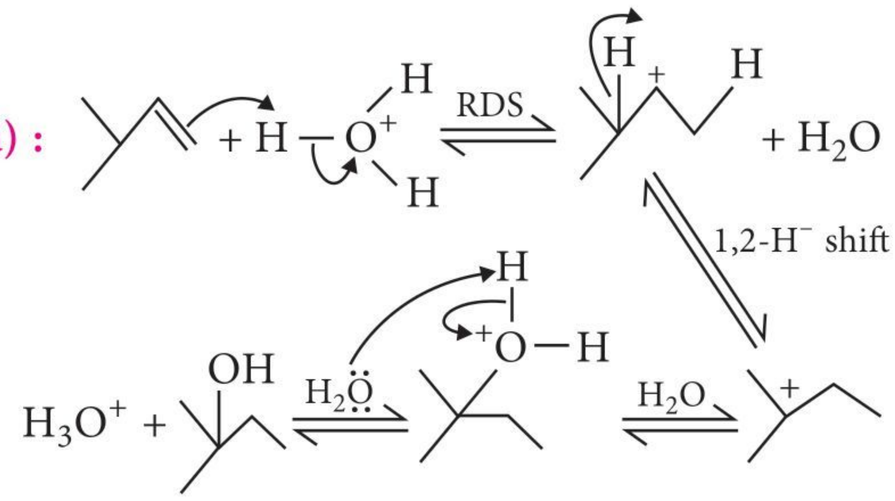
17. CsCl has cubic structure. Its density is 3.99 g cm^{-3}. The distance between Cs^+ and Cl^- ions in pm is (Atomic mass of Cs = 133)

18. At 20°C, two balloons of equal volume and porosity are filled to a pressure of 2 atm, one with 14 kg N_2 and other with 1 kg of H_2. The N_2 balloon leaks to a pressure of 1/2 atm in 1 hr. The time taken for H_2 balloon to reach a pressure of 1/2 atm is _____.

SOLUTIONS

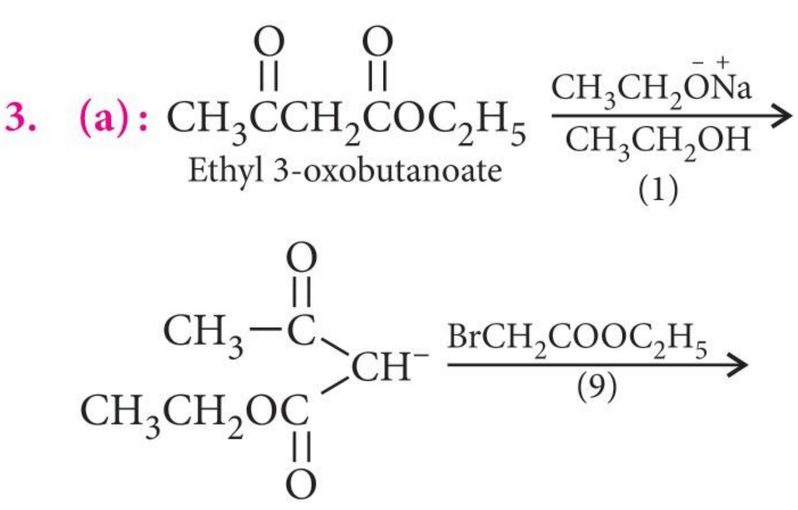
PAPER - I

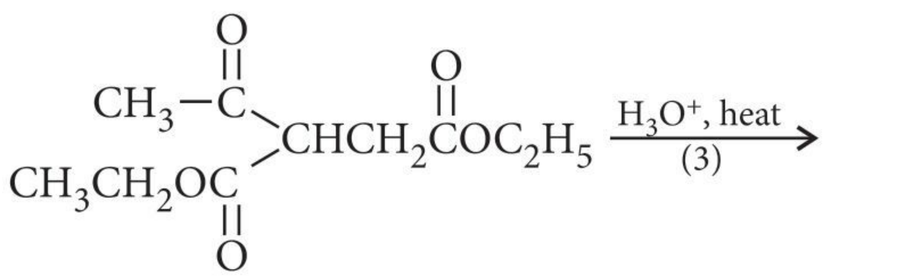
1. (a) :

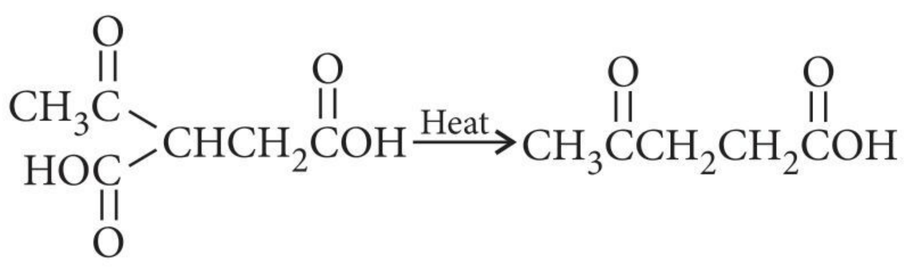


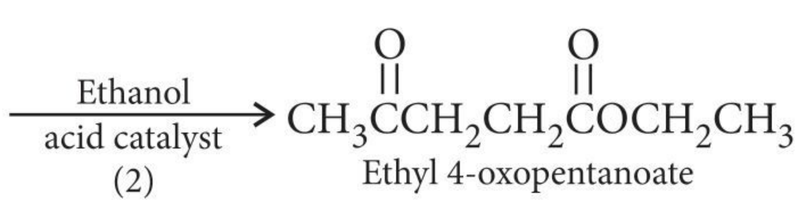
2. (c) : Sulphide ore is concentrated by froth floatation method.

3. (a) :

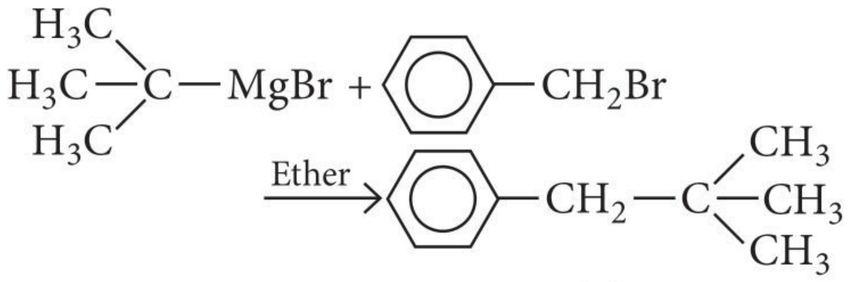








4. (b) :



5. (a) : Volume of unit cell = $(5 \times 10^{-8})^3$ cc
$= 1.25 \times 10^{-22}$ cc

Density of FeO = 4g/cc

Mass of unit cell = $1.25 \times 10^{-22} \times 4 = 5 \times 10^{-22}$ g

Mass of 1 molecule $= \dfrac{72}{6.022\times10^{23}} = 1.195\times10^{-22}$ g

Hence, number of FeO molecules per unit cell

$= \dfrac{5\times10^{-22}}{1.195\times10^{-22}} = 4.18 \approx 4$

Hence, there are four Fe^{2+} and four O^{2-} ions in each unit cell.

6. (a): The bond angle 180° means *sp*-hybridisation which has 50% *s*-character.

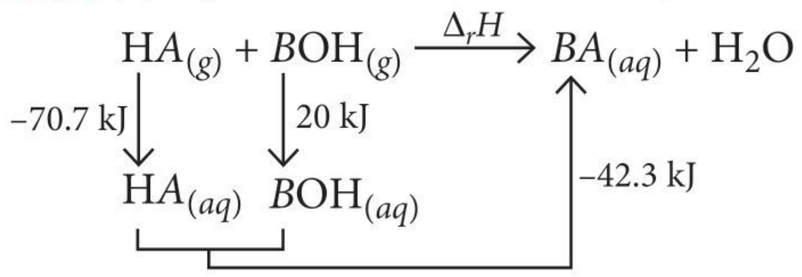
7. (b, c, d) :

$X = [Fe(H_2O)_5NO]SO_4$ and $Y = Na_4[Fe(CN)_5NOS]$
(Brown) (Violet)

There is change in the oxidation state of iron in *X* due to electron transfer from NO to Fe^{2+}.
$[Fe(H_2O)_5NO]SO_4$ contains 3 unpaired electrons.

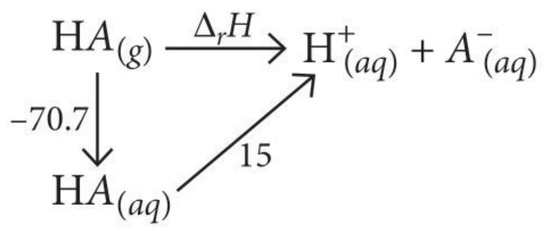
8. (a, b, c) : (a) $\Delta_r H = 15 - 57.3 = -42.3$ kJ/mol

(b)



$\Delta_r H = -70.7 + 20 - 42.3 = -93$ kJ/mol

(c)



$\Delta_r H = -70.7 + 15 = -55.7$ kJ/mol

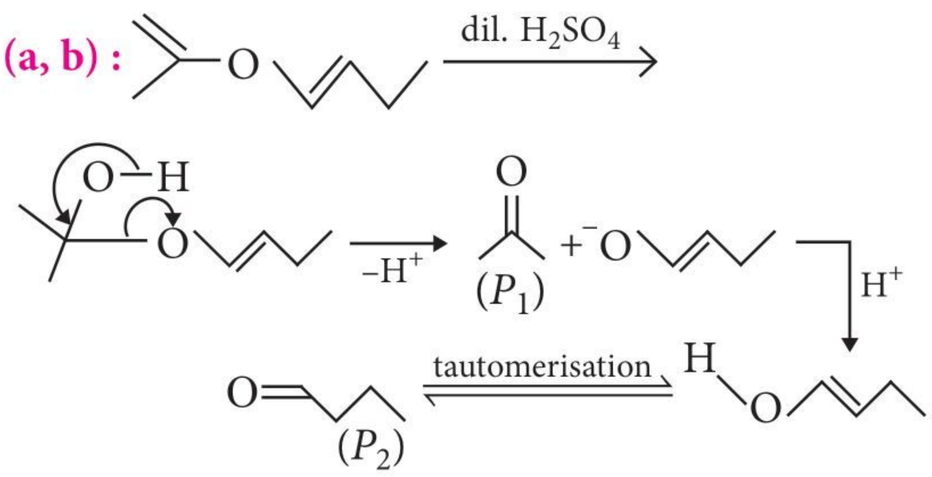
(d) $BOH_{(g)} \longrightarrow BOH_{(aq)}$; $\Delta H = 20$ kJ/mol

$BOH_{(aq)} \longrightarrow B^+_{(aq)} + OH^-_{(aq)}$; $\Delta H = -57.3$ kJ/mol

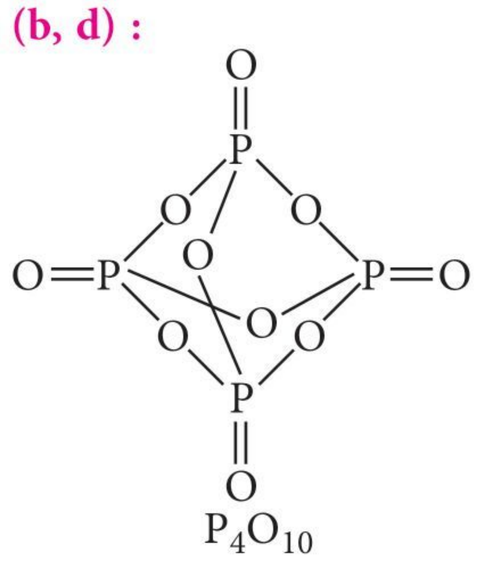
Total $\Delta_r H = 20 - 57.3 = -37.3$ kJ/mol

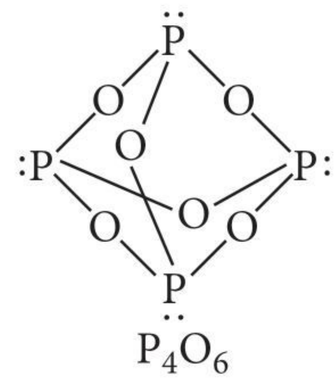
9. (a, b, c) : The energy required to pull out another electron from A^+ is very high *i.e.*, $I.E._2$ is very high. Consequently it is not possible for *A* to form A^{2+} ion under ordinary conditions. Therefore, *A* will be ionized only once and thus will form compounds with valency one like *A*F, A_2O, and A_3N.

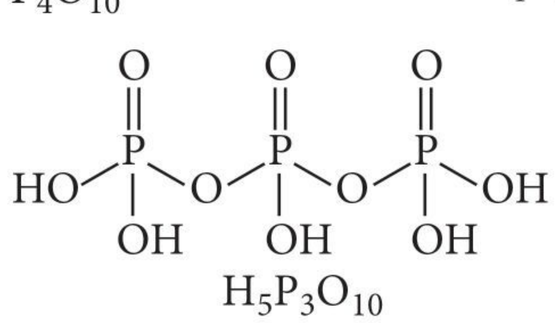
10. (a, b) :

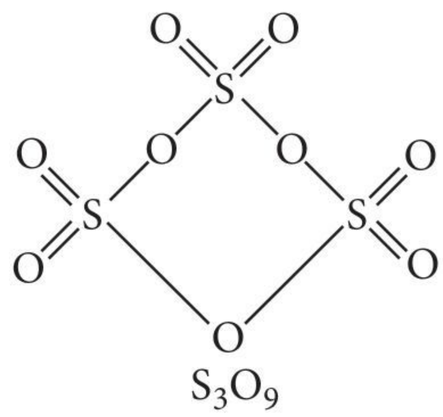


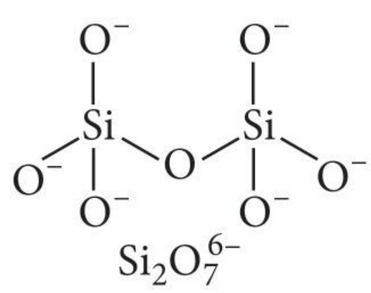
11. (b, d) :











12. (a, b c, d)

13. (10.73 × 10^{-19}) : $E_0 = h\nu_0 = \dfrac{hc}{\lambda_0}$

$= \dfrac{6.625\times10^{-34}\times3\times10^8}{230\times10^{-9}} = 8.64\times10^{-19}$

For spectral line in Lyman series of H-atom

$\dfrac{1}{\lambda} = R\left[1-\dfrac{1}{n^2}\right]$

For the second longest wavelength, $n = 3$

$\dfrac{1}{\lambda} = \dfrac{8}{9}R = \dfrac{8}{9}(1.09677\times10^7) \Rightarrow \lambda = 1.026\times10^{-7}$ m

Energy of photon corresponding to this wavelength is

$E = \dfrac{hc}{\lambda} = \dfrac{6.625\times10^{-34}\times3\times10^8}{1.026\times10^{-7}} = 1.937\times10^{-18}$ J

K.E. of photoelectron $= E - E_0$

$= 19.37\times10^{-19} - 8.64\times10^{-19} = 10.73\times10^{-19}$ J

14. (1.52) : $K_a = \frac{C\alpha^2}{1-\alpha} \Rightarrow 1.6\times10^{-5} = \frac{0.01\times\alpha^2}{1-\alpha}$

$$\alpha = \sqrt{\frac{1.6\times10^{-5}}{0.01}} = 0.04$$

[$\because$ $(1-\alpha) \simeq 1$ when α is small.]

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\infty} \Rightarrow \Lambda_m = 0.04\times380\times10^{-4}$$

$= 15.2\times10^{-4}\ \text{S m}^2\ \text{mol}^{-1}$

$\kappa = \Lambda_m \times C = 15.2\times10^{-4}\times10^3\times10^{-2}$

$= 1.52\times10^{-2}\ \text{S m}^{-1}$ ($\because$ 1 m^3 = 1000 litre)

$\kappa = G.G^*$ and $G^* = 0.01\ \text{m}^{-1}$,

$$\therefore\ G = \frac{1.52\times10^{-2}}{0.01} = 1.52\ \text{S}$$

15. (3.316) : K_{sp} of $C_6H_5COOAg = [C_6H_5COO^-][Ag^+]$

$= 2.5\times10^{-13}$

In pure water, $S^2 = 25\times10^{-14}$

$S = 5\times10^{-7}$

In pH = 3.19 ; pOH = 10.81 or $[OH^-] = 1.55\times10^{-11}$,

$C_6H_5COO^-$ undergoes hydrolysis to form C_6H_5COOH.

$C_6H_5COO^- + H_2O \rightleftharpoons C_6H_5COOH + OH^-$

$$\therefore\ K_H = \frac{K_w}{K_a} = \frac{[C_6H_5COOH][OH^-]}{[C_6H_5COO^-]}$$

$$\therefore\ \frac{[C_6H_5COOH]}{[C_6H_5COO^-]} = \frac{K_w}{K_a[OH^-]}$$

$$= \frac{10^{-14}}{6.46\times10^{-5}\times1.55\times10^{-11}} = 10$$

$[Ag^+]$ dissolved in pH 3.19

= $[C_6H_5COO^-]$ left after hydrolysis + $[C_6H_5COOH]$ formed due to hydrolysis

$= [C_6H_5COO^-] + 10[C_6H_5COO^-] = 11[C_6H_5COO^-]$

$$\therefore\ [C_6H_5COO^-] = \frac{[Ag^+]}{11}$$

$$[Ag^+]\ [C_6H_5COO^-] = [Ag^+]\frac{[Ag^+]}{11} = 2.5\times10^{-13}$$

$$\therefore\ [Ag^+] = 1.658\times10^{-6}$$

i.e., solubility is $\frac{1.658\times10^{-6}}{5\times10^{-7}} = 3.316$ times greater than pure water.

16. (0.527) : E of light absorbed in one photon = $\frac{hc}{\lambda_{absorbed}}$

Let n_1 photons are absorbed, therefore,

Total energy absorbed = $\frac{n_1hc}{\lambda_{absorbed}}$

Now, E of light re-emitted out in one photon

$= \frac{hc}{\lambda_{emitted}}$

Let n_2 photons are re-emitted then,

Total energy re-emitted out = $n_2 \times \frac{hc}{\lambda_{emitted}}$

As given, $E_{absorbed} \times \frac{47}{100} = E_{re\text{-}emitted}$

$$\frac{hc}{\lambda_{absorbed}} \times n_1 \times \frac{47}{100} = n_2 \times \frac{hc}{\lambda_{emitted}}$$

$$\therefore\ \frac{n_2}{n_1} = \frac{47}{100}\times\frac{\lambda_{emitted}}{\lambda_{absorbed}} = \frac{47}{100}\times\frac{5080}{4530}$$

$$\therefore\ \frac{n_2}{n_1} = 0.527$$

17. (64) : $3Br_2 + 6OH^- \longrightarrow 5Br^- + BrO_3^- + 3H_2O$ ...(i)

$6H^+ + BrO_3^- + 3C_2O_4^{2-} \longrightarrow Br^- + 6CO_2 + 3H_2O$ ...(ii)

10 mmole of Br_2 produce (10/3) mmole BrO_3^- and

mmoles of CaC_2O_4 required = $\frac{10}{3}\times3 = 10$

$\therefore$ Mass of $CaC_2O_4 = 10\times10^{-3}\times128$

$$\%\ \text{purity} = \frac{10\times10^{-3}\times128}{2}\times100 = 64$$

18. (67.10) : Given : a = 20, $(a-x) = 20\times\frac{75}{100} = 15$; t = 20 min.

For first order reaction, $k = \frac{2.303}{t}\log\frac{a}{(a-x)}$

At 25 °C (298 K),

$$k_1 = \frac{2.303}{20}\log\frac{20}{15} = 0.014386\ \text{min}^{-1}$$

At 40 °C (313 K); k_2 = ?

We know that, $\log\frac{k_2}{k_1} = \frac{E_a}{2.303\,R}\left[\frac{T_2-T_1}{T_1\times T_2}\right]$

$$\therefore\ \log\frac{k_2}{0.014386} = \frac{70\times10^3}{2.303\times8.314}\times\left(\frac{313-298}{298\times313}\right)$$

$$\log\frac{k_2}{0.014386} = \frac{70\times10^3}{2.303\times8.314}\times\frac{15}{298\times313} = 0.588$$

$$\frac{k_2}{0.014386} = 3.864 \quad \text{or} \quad k_2 = 0.0556$$

Now, for per cent decomposition at 40 °C (313 K),
Given, $a = 30$, $(a - x) = m$, $t = 20$ min, $k = 0.0556$

Thus, $k_{313} = \frac{2.303}{20}\log\frac{30}{m}$

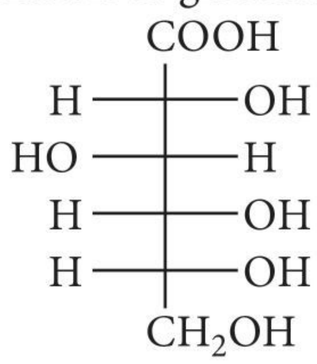
or $0.0556 = \frac{2.303}{20}\log\frac{30}{m} \Rightarrow m = 9.869$

% decomposition $= \frac{a-m}{a} = \frac{30-9.869}{30} \times 100$

$= 67.10$

PAPER - II

1. (4): After ring opening oxidation of α - *D* - glucose leads to the formation of gluconic acid.



2. (7): Let the mixture contains acetaldehyde and ethanol of mass a and b g respectively.

$\therefore \quad a + b = 5.26$ g

The mixture reacts with Fehling's solution to give a red ppt., a characteristic reaction for aldehydes, *i.e.*,

$CH_3CHO + 2CuO \longrightarrow CH_3COOH + Cu_2O$

red ppt.

$\because$ 143 g Cu_2O is formed from 44 g CH_3CHO

$\therefore$ 1.2 g Cu_2O is formed from

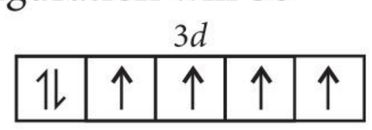
$\frac{44 \times 1.2}{143}$ g $CH_3CHO = 0.369$ g CH_3CHO

$\therefore$ Wt. of acetaldehyde = 0.369 g

Percentage of acetaldehyde $= \frac{0.369}{5.26} \times 100 = 7\%$

3. (4) : $\mu = 4.89 = \sqrt{n(n+2)} \Rightarrow n = 4$

Since, Fe^{2+} has four unpaired electrons so, its configuration will be



Hence, it is a weak field complex.

In weak field complexes, first the t_{2g} and e_g levels are singly occupied and then the pairing of electrons in t_{2g} level takes place. Thus, there are 4 electrons in t_{2g} level.

4. (8): $\%S_N1 = \frac{3 \times 10^{-6}\,[\text{substrate}]}{2.35 \times 10^{-5}\,[\text{subs.}] \times 1.5 + 3 \times 10^{-6}\,[\text{subs.}]} \times 100$

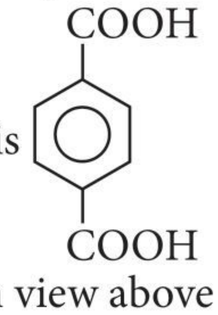
$= 7.824 \approx 8$

5. (2): (i) Aromatic hydrocarbon (*A*) decolourizes Br_2 in CCl_4 and cold aq. $KMnO_4$ and thus (*A*) must have unsaturated aliphatic C=C bond in the chain.

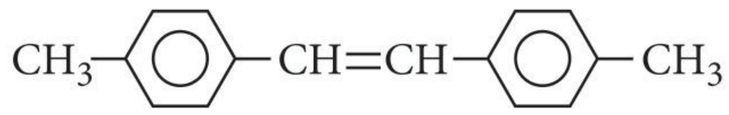
(ii) Addition of one mole of H_2 also confirms one C=C bond in the chain.

(iii) Oxidation of (*A*) by hot $KMnO_4$ gives (*B*), $C_6H_4(COOH)_2$ which gives only one monobromo substitution product, *i.e.*, it should be *p*-isomer.

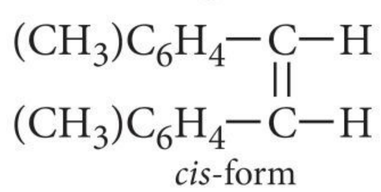
Thus, (*B*) is



keeping in view above facts, (*A*) is

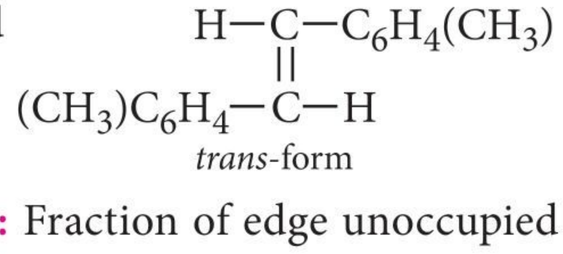


(*A*) shows geometrical isomerism,



cis-form

and



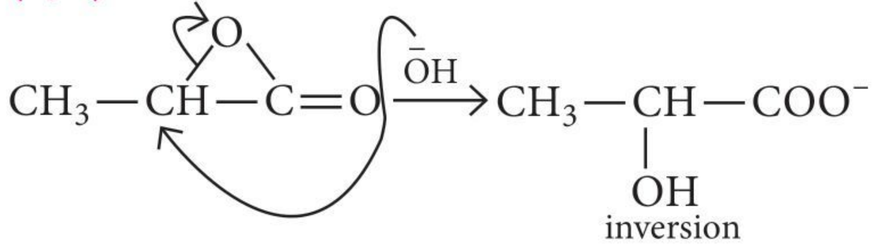
trans-form

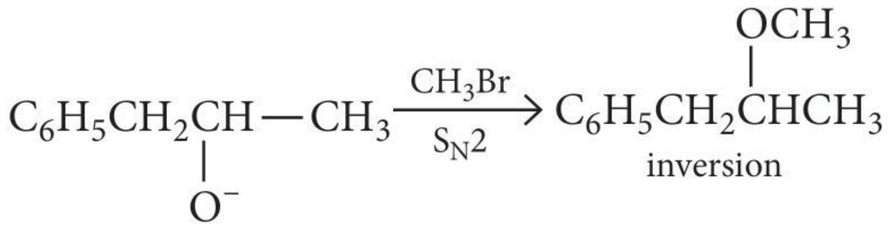
6. (3): Fraction of edge unoccupied $(x) = \frac{a-2r}{a}$

$a = 2\sqrt{2}r$, $x = \frac{2(\sqrt{2}-1)}{2\sqrt{2}} = \frac{0.414}{1.414} = 0.293$

$Z = \frac{x}{0.097} = \frac{0.293}{0.097} = 3$

7. (b, c) :





8. (a, c, d) : $\frac{\Delta P}{P^\circ} = \frac{n_2}{n_1} = \frac{n_2 \times M_{w_1} \times 1000}{W_1 \times 1000}$

$= \frac{\text{Molality} \times M_{w_1}}{1000}$

For electrolyte, $\frac{\Delta P}{P^\circ} = \frac{\text{Molality} \times 18}{1000} \times (1 + 3\alpha)$

($M_{w_1} = 18$, for H_2O)

Also, $\pi_{obs} = C \times R \times T(1 + 3\alpha)$

$$\therefore \quad \frac{\Delta P}{P^\circ} = \frac{\pi_{obs}}{RT} \times \frac{18}{1000}$$

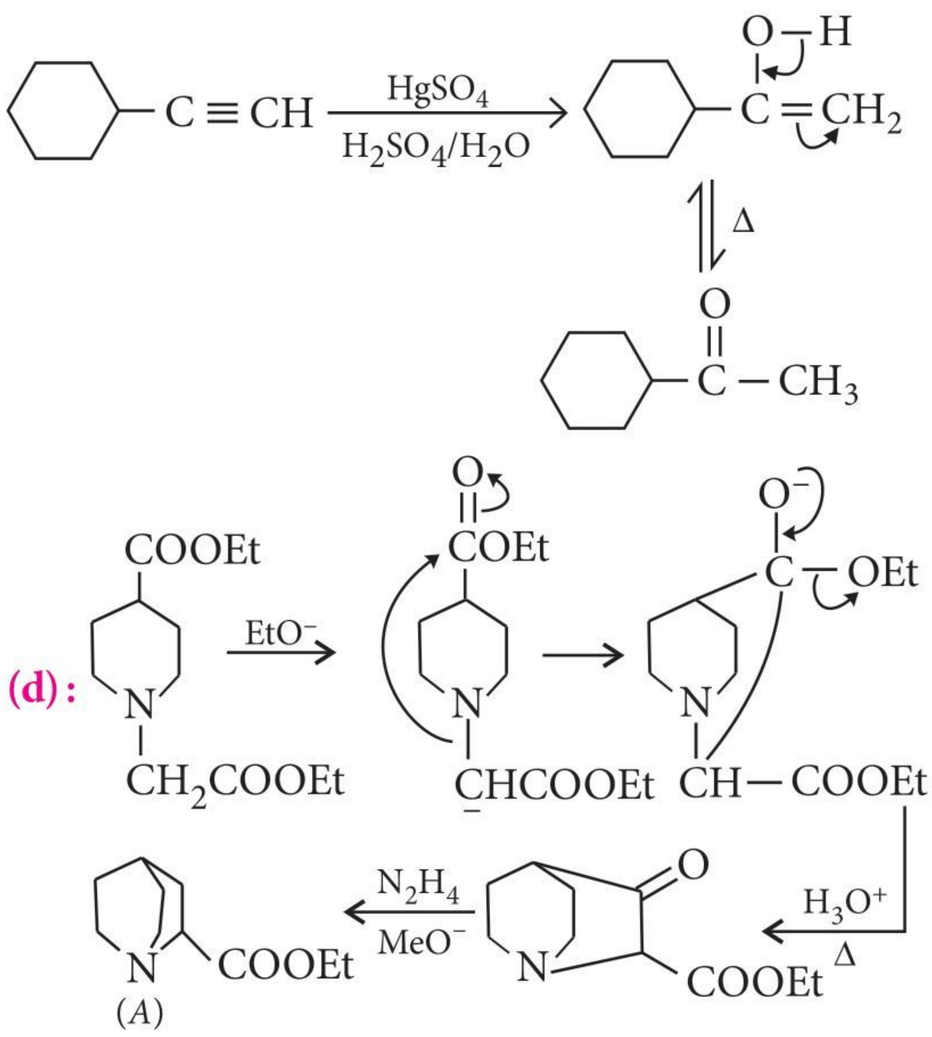
$$\Delta T_{f\,(obs)} = K_f \times \text{molality} \times (1 + 3\alpha)$$

$$\frac{\Delta P}{P^\circ} = \frac{\Delta T_{f\,(obs)} \times 18}{K_f \times 1000}$$

$$i = (1+3\alpha) = \frac{\text{Calculated molecular weight}}{\text{Observed molecular weight}}$$

Therefore, molecular weight of K_3PO_4
$= M_{w(obs)} \times (1 + 3\alpha)$

9. (b): $R-C\equiv CH$ is converted to ketone by catalytic hydration with reagents given in option (b).



10. (d):

11. (b): Copper extraction

$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$

$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$

The solidified copper obtained has blistered appearance due to the evolution of SO_2 and therefore, it is called blister copper.

12. (a, c, d) : $MnSO_4 + 2Na_2CO_3 + 2KNO_3 \xrightarrow{\text{Fuse}}$
(A)

$Na_2MnO_4 + 2KNO_2 + Na_2SO_4 + 2CO_2$
(B) (Green)

$3Na_2MnO_4 + 2H_2SO_{4(\text{dil.})} \rightarrow 2NaMnO_4 + MnO_2 +$
(B) (C)

$6Na_2SO_4 + 4H_2O$

$MnSO_4 + 8NaOH + 3Br_{2(aq.)} \rightarrow MnO_2 + Na_2SO_4 +$
(A) (D)

$6NaBr + 4H_2O$

$MnSO_{4\ (\text{in dil.HCl})} + BaCl_2 \rightarrow BaSO_4 \downarrow + MnCl_2$
(A) (E)

13. (4.9×10^{-2}) : Moles of NH_4HS introduced

$$= \frac{\text{Weight of } NH_4HS}{\text{Mol. Wt. of } NH_4HS} = \frac{3.06}{51} = 0.06 \text{ mol}$$

Hence molar conc. of NH_4HS in solution

$$= \frac{0.06}{2} = 0.03 \text{ mol } L^{-1}$$

Degree of dissociation of NH_4HS = 30%

So, moles of NH_4HS dissociated $= \frac{0.03 \times 30}{100}$

$= 0.009$ mol

	$NH_4HS_{(s)} \rightleftharpoons$	$NH_{3(g)}$	+	$H_2S_{(g)}$
Initial	0.03	0		0
Equilibrium	0.03 – 0.009 = 0.021	0.009		0.009

$\therefore \quad K_c = [NH_{3(g)}]\,[H_2S_{(g)}] = 0.009 \times 0.009$

[Conc. of solid = 1]

$= 8.1 \times 10^{-5} \text{ mol}^2 \text{ L}^{-2}$

$K_p = K_c \times (RT)^{\Delta n_g} = 8.1 \times 10^{-5} \times (0.082 \times 300)^2$

$[\because \ \Delta n_g = 2 - 0 = 2]$

$= 4.9 \times 10^{-2} \text{ atm}^2$

14. (6.8×10^{-4}) :

$$E_{\text{cell}} = E^\circ_{OP_{Ag/Ag^+}} + E^\circ_{RP_{Ag^+/Ag}} + \frac{0.059}{1} \log \frac{[Ag^+]_{\text{R.H.S}}}{[Ag^+]_{\text{L.H.S}}}$$

$$\text{or} \quad 0.0860 = \frac{0.059}{1} \log \frac{[Ag^+]_{\text{R.H.S}}}{[Ag^+]_{\text{L.H.S}}}$$

Also $[Ag^+]_{\text{L.H.S.}}$ can be derived as

$$[Ag^+] = \sqrt{K_{sp(AgI)}} = \sqrt{8.5 \times 10^{-17}} = 9.22 \times 10^{-9} \text{ M}$$

$$\therefore \quad 0.0860 = \frac{0.059}{1} \log \frac{[Ag^+]_{\text{R.H.S.}}}{9.22 \times 10^{-9}}$$

$$\text{or} \quad \frac{[Ag^+]_{\text{R.H.S.}}}{9.22 \times 10^{-9}} = 28.68$$

$$\therefore \quad [Ag^+]_{\text{R.H.S.}} = 28.68 \times 9.22 \times 10^{-9} \text{ M}$$

Also for R.H.S.

$[Ag^+][Cl^-] = K_{sp(AgCl)}$

$$\therefore \quad [Cl^-] = \frac{K_{sp(AgCl)}}{[Ag^+]} = \frac{1.8 \times 10^{-10}}{28.68 \times 9.22 \times 10^{-9}}$$

or $\quad [Cl^-] = 6.8 \times 10^{-4} \text{ M}$

15. (46.81) : Let the volume of $\frac{N}{2}$ H_2SO_4 left unused by ammonia = V mL

V mL of this solution was diluted with water upto 150 mL.

20 mL of dilute solution is neutralising 31 mL of $\frac{N}{20}$ NaOH.

Normality of diluted solution can be calculated as

$N_1V_1 = N_2V_2$

or $\quad N_1 \times 20 = \frac{N}{20} \times 31$

$\therefore \quad N_1 = \frac{N}{20} \times 31 \times \frac{1}{20} = \frac{31}{400} \times N$

Normality of 150 mL of acid solution $= \frac{31 \times N}{400}$

Volume of $\frac{N}{2}$ H_2SO_4 left unused by NH_3 can be calculated as : $N_1V_1 = N_2V_2$

or $\quad V \times \frac{N}{2} = \frac{31 \times N}{400} \times 150$

$\therefore \quad V = \frac{31 \times 150 \times 2}{400} = 23.25 \text{ mL}$

Thus volume of $\frac{N}{2}$ H_2SO_4 left = 23.25 mL

Thus volume of acid used to neutralise NH_3

= 50 – 23.25 = 26.75 mL of $\frac{N}{2}$ normality

This will be volume of NH_3 liberated with normality $\frac{N}{2}$,

So, $\%\,N = \frac{1.4 \times V \times N_1}{W} = \frac{1.4 \times 26.75 \times 1}{0.4 \times 2} = 46.81\%$

16. (–7981.44 J) : $C_{v,m} = \frac{n_1C_{v,m_1} + n_2C_{v,m_2}}{n_1 + n_2} = 2\ R$

For adiabatic process, $dU = dW$

$$\frac{dT}{T} = -\frac{R}{C_{v,m}}\left(\frac{dV}{V}\right)$$

$$n_1C_{v,m_1}dT + n_2C_{v,m_2}dT = -(n_1RT + n_2RT) \times \frac{dV}{V}$$

$$\ln\frac{T_2}{T_1} = -\frac{1}{2}\ln\left(\frac{V_2}{V_1}\right) \quad \Rightarrow \quad T_2 = 320 \times \left(\frac{1}{4}\right)^{1/2}$$

= 160 K

$\Delta U = (n_1C_{v,m_1} + n_2C_{v,m_2})\Delta T = -960\ R$

= – 960 × 8.314 = – 7981.44 J

17. (356.8) : CsCl has *bcc* structure, so $Z_{eff} = 1$

$$\rho = \frac{Z_{eff} \times M}{a^3 \times 10^{-30} \times N_A} \text{ or } a^3 = \frac{Z_{eff} \times M}{\rho \times 10^{-30} \times N_A}$$

$$= \frac{1 \times (133 + 35.5)}{3.99 \times 10^{-30} \times 6.02 \times 10^{23}} = 70.15 \times 10^6$$

$a = (70.15)^{1/3} \times 10^2 = 4.12 \times 10^2$ pm = 412 pm

$$\text{Interionic distance} = \frac{\sqrt{3}a}{2} = \frac{1.732}{2} \times 412 = 356.8 \text{ pm}$$

18. (16) : At constant V and T for a gas $P \propto w$

Thus, for N_2 : P_1 = 2 atm, $P_2 = \frac{1}{2}$ atm, at t = 1 hr, w_1 = 14 kg, w_2 = ?

$\because \quad \frac{P_1}{P_2} = \frac{w_1}{w_2}; \frac{2}{1/2} = \frac{14}{w_2}$

$\therefore \quad w_2 = \frac{14}{4}$ kg N_2

$\therefore \quad$ wt. of N_2 diffused $= 14 - \frac{14}{4} = \frac{42}{4} = \frac{21}{2}$ kg

Similarly, for H_2 : P_1 = 2 atm, $P_2 = \frac{1}{2}$ atm, at $t = t$ hr, w_1 = 1 kg, w_2 = ?

$\because \quad \frac{P_1}{P_2} = \frac{w_1}{w_2}$

$\frac{2}{1/2} = \frac{1}{w_2} \quad \therefore \ w_2 = \frac{1}{4}$ kg

$\therefore \quad$ wt. of H_2 diffused $= 1 - \frac{1}{4} = \frac{3}{4}$ kg

Now $\frac{r_{N_2}}{r_{H_2}} = \sqrt{\left(\frac{M_{H_2}}{M_{N_2}}\right)}$ for diffusion of N_2 and H_2

or $\quad \frac{w_{H_2}}{w_{N_2}} \times \frac{t_{N_2}}{t_{H_2}} = \sqrt{\left(\frac{M_{H_2}}{M_{N_2}}\right)}$

$$\frac{3/4}{21/2} \times \frac{60}{t} = \sqrt{\left(\frac{2}{28}\right)}$$

$\therefore \quad t$ = 16 minutes

MONTHLY TEST DRIVE CLASS XII ANSWER KEY

1.	(d)	**2.**	(c)	**3.**	(c)	**4.**	(a)	**5.**	(d)
6.	(a)	**7.**	(c)	**8.**	(c)	**9.**	(a)	**10.**	(c)
11.	(c)	**12.**	(b)	**13.**	(d)	**14.**	(d)	**15.**	(b)
16.	(c)	**17.**	(d)	**18.**	(d)	**19.**	(b)	**20.**	(b,c,d)
21.	(a,c)	**22.**	(b,d)	**23.**	(b,c)	**24.**	(1)	**25.**	(4)
26.	(0)	**27.**	(d)	**28.**	(b)	**29.**	(a)	**30.**	(d)

PRACTICE PAPER

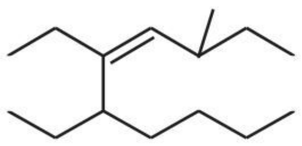
NEET 2021

1. To prepare a buffer of pH 8.26 amount of $(NH_4)_2SO_4$ to be added to 500 mL of 0.01 M NH_4OH solution $[pK_a(NH_4^+) = 9.26]$ is
(a) 0.05 mole (b) 0.025 mole
(c) 0.10 mole (d) 0.005 mole.

2. Which of the following compounds is not coloured?
(a) $Na_2[CuCl_4]$ (b) $Na_2[CdCl_4]$
(c) $K_4[Fe(CN)_6]$ (d) $K_3[Fe(CN)_6]$

3. The volume strength of 2.5 N H_2O_2 solution is
(a) 4.8 (b) 14 (c) 3.0 (d) 12

4. The correct IUPAC name of the compound,



is
(a) 5,6-diethyl-8-methyldec-6-ene
(b) 6-butyl-5-ethyl-3-methyloct-4-ene
(c) 5,6-diethyl-3-methyldec-4-ene
(d) 2,4,5-triethylnon-3-ene.

5. A complex is prepared by mixing $CoCl_3$ and NH_3. 0.1 M solution of the complex was found to freeze at –0.372°C. The formula of the complex is
[Molal depression constant of water = 1.86°C/m]
(a) $[Co(NH_3)_6]Cl_3$ (b) $[Co(NH_3)_5Cl]Cl_2$
(c) $[Co(NH_3)_4Cl_2]Cl$ (d) $[Co(NH_3)_3Cl_3]$

6. Some of alkali metal salts are coloured, *e.g.*, Na_2CrO_4 —yellow, $KMnO_4$ — pink, K_2MnO_4 — green. It is due to
(a) cations are coloured ions
(b) anions are coloured ions
(c) both (a) and (b) are correct
(d) none of the above is correct.

7. Which of the following statements about primary amines is false?
(a) Aryl amines react with nitrous acid to produce nitrophenols.
(b) Alkyl amines are stronger bases than ammonia.
(c) Alkyl amines are stronger bases than aryl amines.
(d) Alkyl amines react with nitrous acid to produce alcohols.

8. Which of the following statements is true for N_3^- ?
(a) It has non-linear structure.
(b) It is called pseudohalogen.
(c) The formal oxidation state of nitrogen in this anion is +1.
(d) It is isoelectronic with N_2O.

9. Which of the following is not a property of hydrophilic sols?
(a) High concentration of dispersed phase can be easily attained.
(b) Coagulation is reversible.
(c) Viscosity and surface tension are nearly same as that of water.
(d) The charge of the particle depends on the pH value of the medium; it may be positive, negative or even zero.

10. A binary solid (A^+B^-) has a zinc blende structure with B^- ions constituting the lattice and A^+ ions occupying 25% tetrahedral holes. The formula of the solid is
(a) AB_2 (b) AB (c) A_2B (d) AB_4

11. Cl_2 and SO_2 are pollutants as well as bleaching agents. Their bleaching action is due to

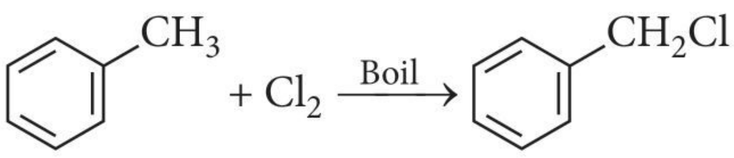
	SO_2	**Cl_2**
(a)	Oxidation	Oxidation
(b)	Reduction	Reduction
(c)	Oxidation	Reduction
(d)	Reduction	Oxidation

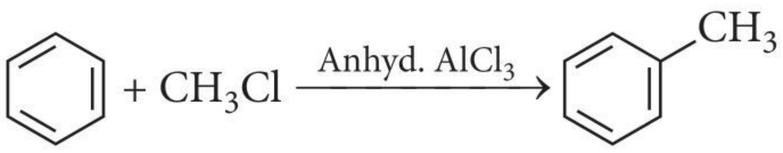
12. Benzaldehyde reacts with ammonia to form
(a) hydrobenzamide (b) benzamide
(c) aniline (d) phenyl cyanide.

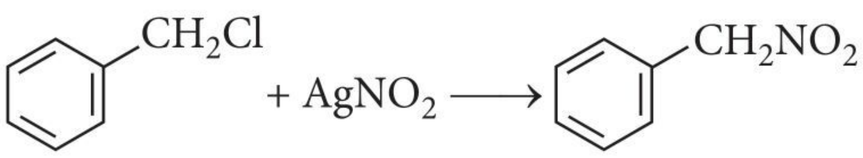
13. A solution of $Al_2(SO_4)_3$ (d = 1.253 g/mL) contains 22.0% salt by weight, the molarity, normality and molality of the solution respectively are
(a) 0.805 M, 4.83 N, 0.825 m
(b) 0.825 M, 48.3 N, 0.805 m
(c) 4.83 M, 4.83 N, 4.83 m
(d) 4.50 M, 4.67 N, 4.93 m

14. The number of geometrical isomers in case of a compound with the structure,
$CH_3 - CH = CH - CH = CH - C_2H_5$ are
(a) four (b) three (c) two (d) five.

15. Which of the following is a free radical substitution reaction?

(a) 

(b) 

(c) 

(d) $CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$

16. Which one of the following pairs of reactants does not form oxygen when they react with each other?
(a) F_2, NaOH solution (hot, conc.)
(b) F_2, H_2O
(c) Cl_2, NaOH solution (hot, conc.)
(d) Na_2O_2, H_2O

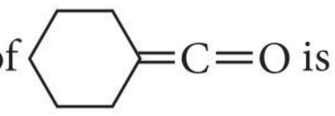
17. Borax is converted into B by the following steps:

$$\text{Borax} \xrightarrow{\text{I}} H_3BO_3 \xrightarrow{\Delta} B_2O_3 \xrightarrow{\text{II}} \text{B}$$

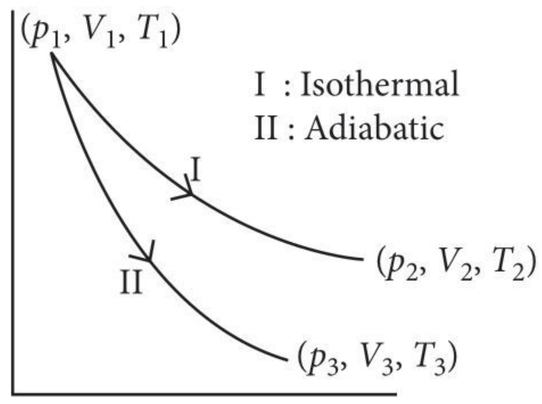
I and II reagents are respectively
(a) base, Al (b) acid, C
(c) acid, Ag (d) acid, Mg

18. The resistance of 0.5 N solution of an electrolyte in a conductivity cell was found to be 25 ohm. Calculate the equivalent conductivity of the solution if the electrodes in the cell are 1.6 cm apart and have an area of 3.2 cm^2.
(a) 10 S cm^2 equiv (b) 15 S cm^2 equiv
(c) 20 S cm^2 equiv (d) 40 S cm^2 equiv

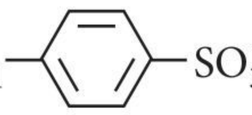
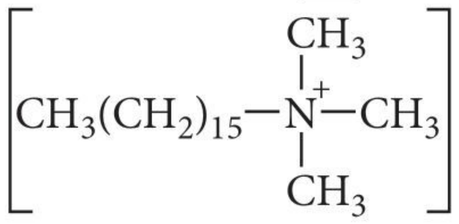
19. Which of the following statements is not correct regarding ionisation energy of d-series?
(a) IE of Mn is higher than Cr.
(b) IE of Pd is higher than Rh and Ag both.
(c) IE for 5d series is much higher than 3d and 4d series.
(d) IE of Zr is higher than Hf.

20. The IUPAC name of  is
(a) cyclohexanone
(b) cyclohexylmethanone
(c) oxycyclohexene
(d) cyclohexylidenemethanone.

21. The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the following figure. Select incorrect statement.

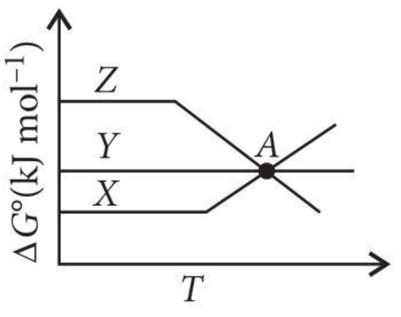


(a) $T_3 < T_1$ (b) $\Delta E_{isothermal} > \Delta E_{adiabatic}$
(c) $T_1 = T_2$ (d) $w_{isothermal} > w_{adiabatic}$

22. Which of the following is an example of liquid dishwashing detergent?
(a) $CH_3(CH_2)_{10}CH_2OSO_3^-Na^+$
(b) $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$
(c) $CH_3(CH_2)_{11}$–  –$SO_3^-Na^+$
(d) 

23. When neopentyl bromide is subjected to Wurtz reaction, the product formed is
(a) 2, 2, 4, 4-tetramethylhexane
(b) 2, 2, 4, 4-tetramethylpentane
(c) 2, 2, 5, 5-tetramethylhexane
(d) 2, 2, 3, 3-tetramethylhexane.

24. In the following Ellingham diagram, X, Y and Z represent graphs for metal oxides. Select the correct option before point A.
(a) Y will reduce oxide of Z.
(b) Y will reduce oxide of X.
(c) Z will reduce oxide of X.
(d) Z will reduce oxide of Y.



25. H_2O_2 used in rocket has the concentration
(a) 50% (b) 70% (c) 30% (d) 90%

26. The density of sodium borohydride is 1.074 g/cm^3. 3.91 g of sodium borohydride contains 2.50×10^{23} atoms of H. The number of moles of H atoms present in 28.0 cm^3 of sodium borohydride is

(a) 3.192 (b) 2.03

(c) 1.67 (d) 1.92

27. Which of the following alcohols is most reactive with HCl in the presence of $ZnCl_2$?

(a) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-OH$ (b) $CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2OH$

(c) $CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-OH$ (d) CH_3OH

28. In Buna-S, symbol 'Bu' stands for

(a) 1-butene (b) 2-butene

(c) *n*-butene (d) butadiene.

29. The red coloured compound formed during the Victor Meyer's test for ethyl alcohol is

(a) $CH_3-\underset{\displaystyle NO_2}{\overset{|}{C}}=NO^-Na^+$ (b) $CH_3-\underset{\displaystyle NO_2}{\overset{|}{CH}}-NO_2^-Na^+$

(c) $CH_3-\underset{\displaystyle NO}{\overset{|}{CH}}-NO_2$ (d) $(CH_3)_2\underset{\displaystyle NO_2}{\overset{|}{C}}-NO$

30. A ball of mass 200 g is moving with a velocity of 10 m sec^{-1}. If the error in measurement of velocity is 0.1%, the uncertainty in its position is

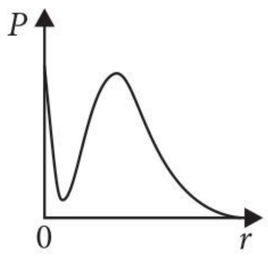
(a) 3.32×10^{-31} m

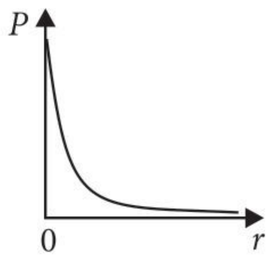
(b) 3.34×10^{-27} m

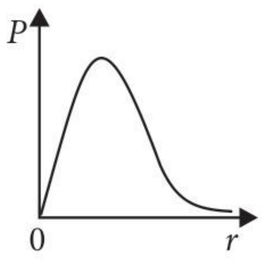
(c) 5.32×10^{-25} m

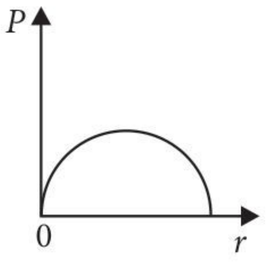
(d) 2.64×10^{-32} m

31. *P* is the probability of finding the 1*s* electron of hydrogen atom in a spherical shell of infinitesimal thickness *dr*, at a distance *r* from the nucleus. The volume of this shell is $4\pi r^2 dr$. The qualitative sketch of the dependence of *P* on *r* is

(a) 

(b) 

(c) 

(d) 

32. The hormone which controls the processes of burning of fats, proteins and carbohydrates and liberates energy in the body is

(a) thyroxine (b) adrenaline

(c) insulin (d) vasopressin.

33. The rate constant is given by the equation $k = P{\cdot}Ze^{-E_a/RT}$. Which factor should register a decrease for the reaction to proceed more rapidly?

(a) *T* (b) *Z* (c) E_a (d) *P*

34. $NaNO_3$ when decomposes above 800 °C does not give

(a) N_2 (b) O_2 (c) NO_2 (d) Na_2O

35. $\underset{(A)}{C_3H_6Cl_2} \xrightarrow[\text{(iii) }\Delta]{\text{(i) KCN}\atop\text{(ii) }H_3O^+} CH_3\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}HCOOH$; (*A*) is

(a) 1,1-dichloropropane

(b) 1,2-dichloropropane

(c) 2,2-dichloropropane

(d) 1,3-dichloropropane.

36. The gases that give rise to photochemical smog are

(a) oxides of sulphur (b) oxides of nitrogen

(c) oxides of carbon (d) oxygen.

37. An organic compound contains C, H, N, S and Cl. For the detection of chlorine, the sodium extract of the compound is first heated with a few drops of dilute HNO_3 and then $AgNO_3$ is added to get a white ppt. of AgCl. The digestion with HNO_3 before the addition of $AgNO_3$ is

(a) to prevent the formation of NO_2

(b) to create a common ion effect

(c) to convert CN^- and S^{2-} to volatile HCN and H_2S, or else they will interfere with the test forming AgCN or Ag_2S

(d) to prevent the hydrolysis of NaCN and Na_2S.

38. The bond dissociation energies of H–H, C–C and C–H bonds respectively are 104.2, 83.1 and 98.8 kcal mol^{-1}. The electronegativity of carbon is

(a) 2.53 (b) 2.81 (c) 2.70 (d) 2.32

39. $C_6H_5\overset{14}{C}OOH$ on heating with Na_2CO_3 releases

(a) CO_2 (b) $\overset{14}{C}O_2$

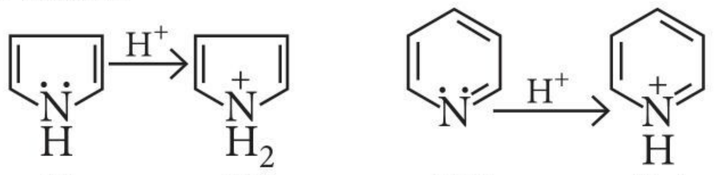
(c) CO (d) none of these.

40. Aluminium crystallizes in a cubic close packed structure. Its metallic radius is 125 pm. What is the length of the side of unit cell?

(a) 145 pm (b) 353.5 pm

(c) 125 pm (d) 250 pm

41. Pyrrole and pyridine both are basic and form salts with acids.



(i) (ii) (iii) (iv)

Which of the following statements is true regarding the aromatic character of the four species?

(a) All the four are aromatic.

(b) i, iii and iv are aromatic.

(c) i, ii and iii are aromatic.

(d) i and ii are aromatic.

42. Compressibility factor (Z) for N_2 at $-50\,°C$ and 800 atm pressure is 1.95. Calculate the number of moles of N_2 gas required to fill a gas cylinder of 100 mL capacity under the given conditions.

(a) 2.24 (b) 1.12

(c) 6.10 (d) 2.90

43. Which of the following is not a consequence of greenhouse effect?

(a) Climatic conditions will be changed.

(b) Plants in warmer climates with adequate rainfall would grow faster.

(c) The incidence of infectious diseases is likely to increase.

(d) Malaria will be controlled as the mosquitoes will not survive.

44. Identify the final product (Z) in the following sequence of reactions :

$$(CH_3)_2CO + HCN \longrightarrow X \xrightarrow{H_3O^+} Y \xrightarrow[\text{Heat}]{H_2SO_4} Z$$

(a) $(CH_3)_2C(OH)COOH$

(b) $CH_2{=}C(CH_3)COOH$

(c) $HOCH_2CH(CH_3)COOH$

(d) $CH_3CH{=}CHCOOH$

45. Which of the following compounds will give white precipitate on heating with HNO_3 followed by addition of silver nitrate?

(a) $(C_2H_5)_3NHCl$

(b) 2, 4, 6-Trinitrochlorobenzene

(c) Both of these (d) None of these

SOLUTIONS

1. (b): For the buffer solution of NH_3 and NH_4^+

$$pH = pK_a + \log\frac{[NH_3]}{[NH_4^+]}$$

$$\Rightarrow \quad 8.26 = 9.26 + \log\frac{(500\times0.01)}{\text{mmoles of } NH_4^+}$$

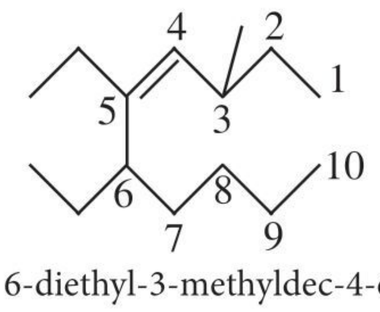
$\Rightarrow$ mmoles of $NH_4^+ = 50$

$\therefore$ moles of $(NH_4)_2SO_4$ required $= 0.025$

2. (b)

3. (b): Volume strength = 5.6 × Normality
= 5.6 × 2.5 = 14

4. (c):



5, 6-diethyl-3-methyldec-4-ene

5. (c): $\Delta T_f = i \times K_f \times m = i \times 1.86 \times 0.1$

or $0.372 = 0.186 \times i$ or $i = 2$

This shows that the complex gives two ions in solution.

Thus, the formula of the complex is $[Co(NH_3)_4Cl_2]Cl$.

$$[Co(NH_3)_4Cl_2]\,Cl \rightleftharpoons [Co(NH_3)_4Cl_2]^+ + Cl^-$$

6. (b)

7. (a)

8. (d): N_3^- has total electrons = 22

Thus, it is isoelectronic of N_2O.

9. (c): Hydrophilic sols have lower surface tension and higher viscosity than that of water.

10. (a): Suppose number of B^- ions constituting the lattice = 100

$\Rightarrow$ No. of tetrahedral sites = 200

As 25 % are occupied by A^+ ions, their number = 50

Ratio of $A^+ : B^- = 50 : 100 = 1 : 2$

Therefore, formula of solid = AB_2

11. (d): SO_2 in the presence of moisture release nascent hydrogen which acts as bleaching agent of flowers, textiles, etc.

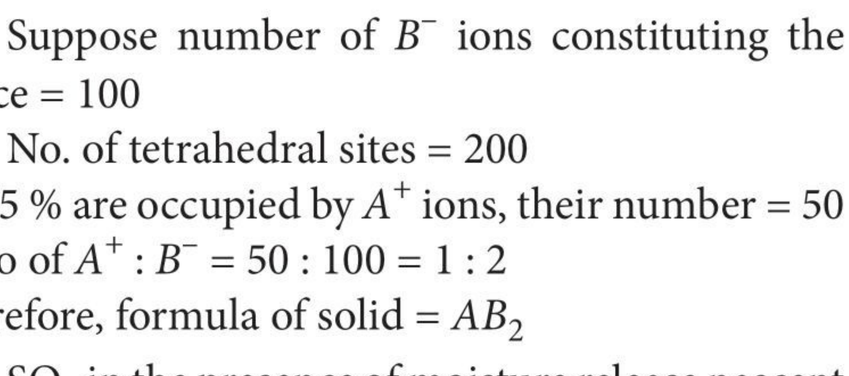
$$SO_2 + 2H_2O \longrightarrow H_2SO_4 + \underset{\text{Bleaching agent}}{2H}$$

Cl_2 in the presence of moisture releases nascent oxygen which acts as bleaching agent.

$$Cl_2 + H_2O \longrightarrow 2HCl + O$$

Bleaching agent

12. (a):



Hydrobenzamide

13. (a) : Volume of 100 g of $Al_2(SO_4)_3 = \frac{100}{1.253} = 79.8$ mL

Amount of $Al_2(SO_4)_3$ in 79.8 mL = 22.0 g

$$\text{Molarity} = \frac{\text{Mass of solute in gram per litre}}{\text{Molar mass of solute}}$$

$$= \frac{22.0}{79.8} \times \frac{1000}{342} = 0.805 \text{ M}$$

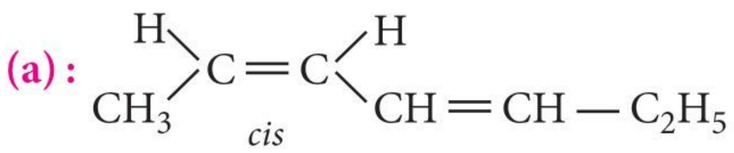
$$\text{Normality} = \frac{\text{Mass of solute in gram per lit.}}{\text{Equivalent weight of solute}}$$

$$= \frac{22.0}{79.8} \times \frac{1000}{56.99} = 4.83 \text{ N}$$

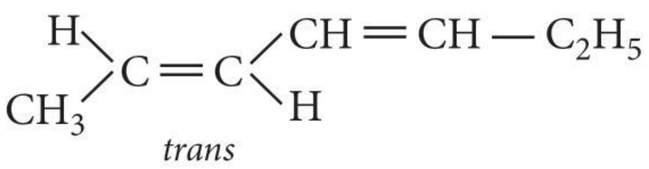
$$\text{Molality} = \frac{\text{Mass of solute per kg of solvent}}{\text{Molar mass of the solute}}$$

$$= \frac{22.0}{78.0} \times \frac{1000}{342} = 0.825 \text{ m}$$

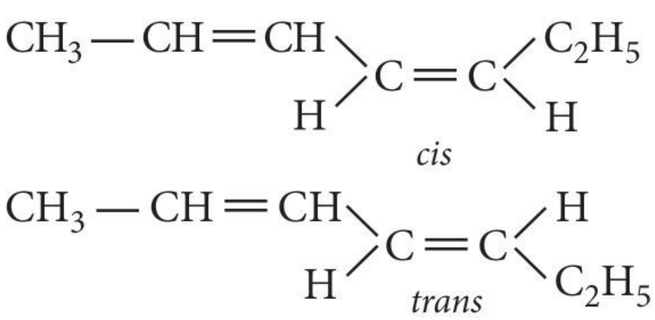
14. (a) :



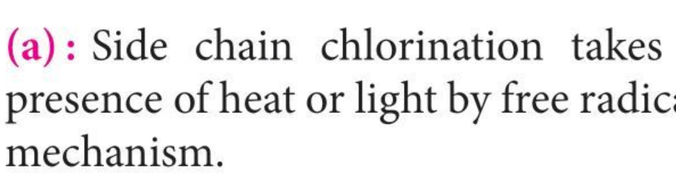
cis



trans



cis



trans

15. (a) : Side chain chlorination takes place in the presence of heat or light by free radical substitution mechanism.

16. (c)

17. (d): $Na_2[B_4O_5(OH)_4].8H_2O \xrightarrow{\text{Acid}}$ (Borax)

$H_3BO_3 \xrightarrow{\Delta} B_2O_3 \xrightarrow{Mg} 2B + 3MgO$

(orthoboric acid)

18. (d): $\rho = R \cdot \frac{a}{l} = \frac{25 \times 3.2}{1.6} = 50$

$\kappa = \frac{1}{\rho} = \frac{1}{50} = 0.02$

$\Lambda_{eq} = \kappa \times V = \kappa \times \frac{1000}{\text{Normality}} = \frac{0.02 \times 1000}{0.5}$

$= 40 \text{ S cm}^2 \text{ equiv.}$

19. (d) **20. (d)**

21. (b): (a) In adiabatic expansion, cooling takes place thus, $T_1 > T_3$

(b) According to first law of thermodynamics,

$\Delta E = q + w$

In isothermal process, $\Delta E = 0$

$\therefore \quad q = -w$

In adiabatic process, $q = 0$

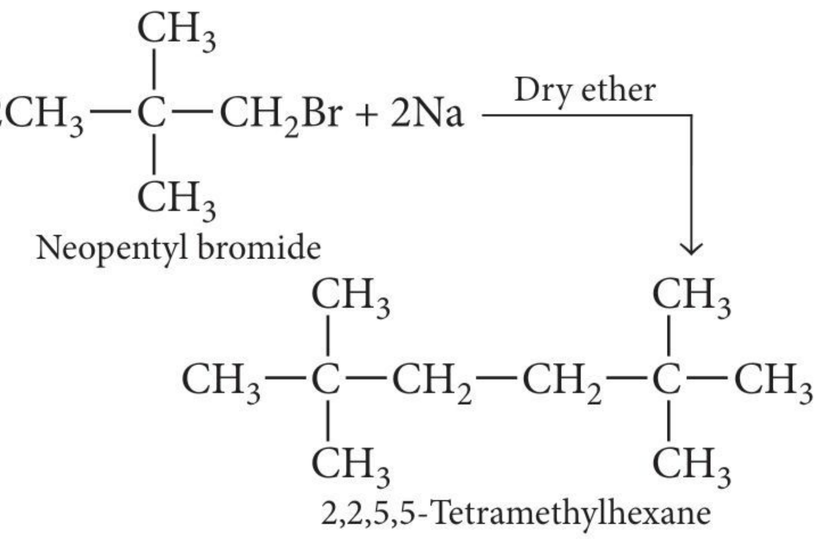
$\therefore \quad \Delta E = w$

(c) Process I is isothermal, $T_1 = T_2$

(d) $w_{\text{isothermal}} > w_{\text{adiabatic}}$

22. (b): Liquid dishwashing detergents are of non-ionic type.

23. (c) :



Neopentyl bromide

2,2,5,5-Tetramethylhexane

24. (a) : $\Delta G°$ of *Y* is less than *Z*.

25. (d): 90% H_2O_2 is used in the rocket fuel.

26. (a) : Weight of sodium borohydride in 28.0 cm^3

$= 28 \times 1.074 = 30.072$ g

$\because$ 3.91 g of sodium borohydride has moles of H atoms

$= \frac{2.50 \times 10^{23}}{6.023 \times 10^{23}}$

$\therefore$ 30.072 g of sodium borohydride has moles of

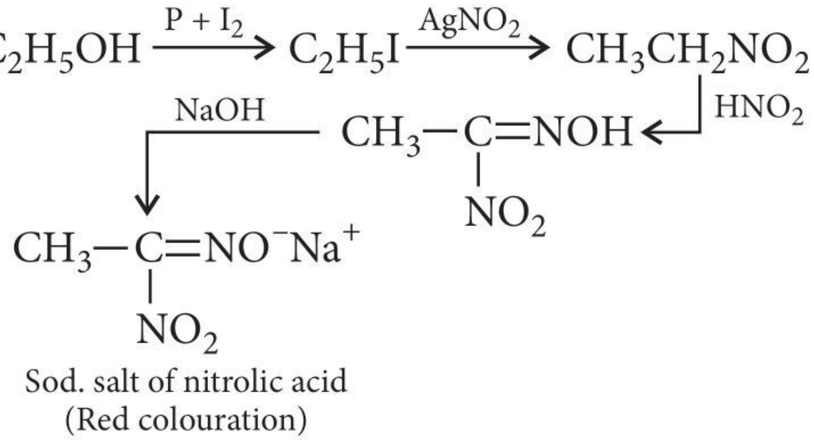
H atoms $= \frac{2.50 \times 10^{23}}{6.023 \times 10^{23}} \times \frac{30.072}{3.91}$

= 3.192 moles of H atoms

27. (a) : Order of reactivity of alcohols towards Lucas reagent : 3° > 2° > 1°

28. (d): In Buna-S (SBR, styrene butadiene rubber), the symbol 'Bu' stands for 1, 3-butadiene ($H_2C = CH—CH = CH_2$).

29. (a) :



Sod. salt of nitrolic acid
(Red colouration)

30. (d): $\Delta v = \frac{0.1}{100} \times 10 = 10^{-2} \text{ m sec}^{-1}$;

Now, $\Delta v \cdot \Delta x = \dfrac{h}{4\pi m}$

$$\Delta x = \frac{6.625\times10^{-34}}{4\times10^{-2}\times3.14\times200\times10^{-3}} = 2.64\times10^{-32}\ \text{m}$$

31. (c) : Probability of finding 1*s* electron is maximum near the nucleus and goes on increasing till it reaches a maximum value at a distance 52.9 pm and then begins to decrease abruptly. Even at large distance from the nucleus, there is a finite though small probability of finding an electron of a given energy.

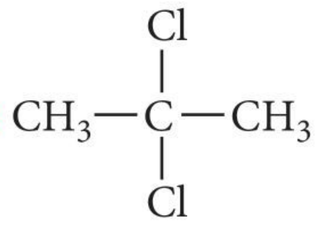
32. (c) : Since insulin maintains the level of glucose in blood, therefore, it controls the processes of burning of fats, proteins and carbohydrates.

33. (c) : Lower the activation energy, faster is the reaction.

34. (c) : $NaNO_3 \xrightarrow{500\ ^\circ C} NaNO_2 + \frac{1}{2}O_2$

$$2NaNO_3 \xrightarrow{> 800\ ^\circ C} Na_2O + N_2 + \frac{5}{2}O_2$$

35. (c) :



36. (b) **37. (c)**

38. (a) : $\Delta = E_{C-H} - \sqrt{E_{H-H}\times E_{C-C}}$

$= 98.8 - (104.2\times83.1)^{1/2} = 5.75$ kcal

$\chi_C - \chi_H = 0.18\sqrt{\Delta} = 0.18\ (5.75)^{1/2} = 0.43$

$\therefore \quad \chi_C = 0.43 + \chi_H = 0.43 + 2.1 = 2.53$

39. (a) : $C_6H_5\overset{14}{C}OOH + Na_2CO_3 \longrightarrow C_6H_5\overset{14}{C}OONa + CO_2 + H_2O$

40. (b) : For a cubic close packed structure, length of the side of unit cell is related to radius as,

$r = \dfrac{a}{2\sqrt{2}}$

$a = r\times2\sqrt{2} = 125\times2\times1.414\ \text{pm} = 353.5\ \text{pm}$

41. (b)

42. (a) : We have, $Z = \dfrac{PV}{nRT}$

$\therefore \quad$ Mole of $N_2(n) = \dfrac{PV}{ZRT}$

$$= \frac{800\times100}{1.95\times0.0821\times223\times1000} = 2.24$$

43. (d)

44. (b) : $(CH_3)_2CO + HCN \longrightarrow CH_3-\underset{\underset{CN}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$ (*X*)

$\xrightarrow{H_3O^+}$

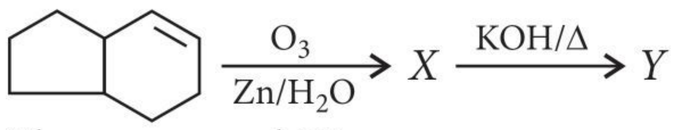
$HOOC-\underset{\underset{CH_3}{|}}{C}=CH_2 \xleftarrow[Heat]{H_2SO_4} CH_3-\underset{\underset{COOH}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$

(*Z*) (*Y*)

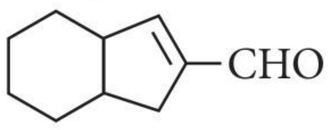
45. (c) : $(C_2H_5)_3N^+HCl^-$ is an ionic compound, so it will form precipitate of AgCl on adding $AgNO_3$. In 2,4,6-trinitrochlorobenzene, due to the presence of three $-NO_2$ groups in *o*- and *p*-ositions, it will be very reactive leading to formation of AgCl on adding HNO_3 and $AgNO_2$.

PRACTICE PAPER

BITSAT

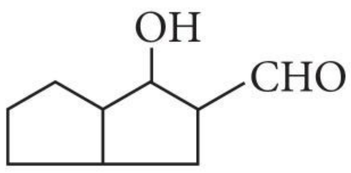
1. 

The compound *Y* is

(a) 

(b) 

(c) 

(d) 

2. Calculate the longest wavelength (in Å) which can remove the electron from first Bohr's orbit.

(Given : $E_1 = 13.6$ eV)

(a) 303.81 (b) 912.24

(c) 1095.12 (d) 1215.67

3. 10 mL of 0.1 M tribasic acid H_3A is titrated with 0.1 M NaOH solution. What is the ratio of $\frac{[H_3A]}{[A^{3-}]}$ at 2nd equivalence point? Given : $K_1 = 7.5 \times 10^{-4}$, $K_2 = 10^{-8}$ and $K_3 = 10^{-12}$

(a) $\sim 10^{-4}$ (b) $\sim 10^{4}$ (c) $\sim 10^{-7}$ (d) $\sim 10^{6}$

4. Natural rubber has

(a) alternate *cis* - and *trans* - configuration

(b) random *cis* - and *trans* - configuration

(c) all *cis* - configuration

(d) all *trans* - configuration.

5. In a fcc unit cell,

x = distance between two nearest octahedral voids

y = distance between two nearest tetrahedral voids

z = distance between two nearest octahedral void and tetrahedral void

Select the correct order of distance.

(a) $x = y = z$ (b) $x < y < z$

(c) $x > y < z$ (d) $x > y > z$

6. Ethylbenzene when treated with chlorine in the presence of light mainly gives

(a) β-phenylethyl chloride

(b) α-phenylethyl chloride

(c) *o*-chloroethyl benzene

(d) *o*-and *p*-chloroethyl benzene.

7. A compound exists in the gaseous phase both as monomer (A) and dimer (A_2). The molecular weight of A is 48. In an experiment 96 g of the compound was confined in a vessel of volume 33.6 litre and heated to 273°C. The pressure developed if the compound exists as dimer to the extent of 50% by weight under these conditions is

(a) 2 atm (b) 4 atm

(c) 3 atm (d) 5 atm

8. The product of acid catalysed hydration of 2-phenyl propene is

(a) 3-phenyl-2-propanol (b) 1-phenyl-2-propanol

(c) 2-phenyl-2-propanol (d) 2-phenyl-1-propanol.

9. Gold numbers of protective colloids A, B, C and D are 0.50, 0.01, 0.10 and 0.005 respectively. The correct order of their protective powers is

(a) $D < A < C < B$ (b) $C < B < D < A$

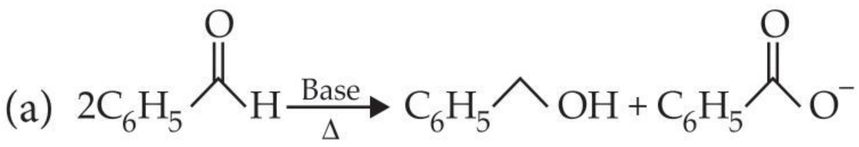
(c) $A < C < B < D$ (d) $B < D < A < C$

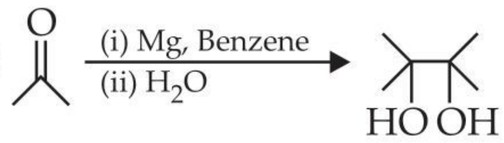
10. The amount of $Ca(OH)_2$ required to remove the hardness of water from 60,000 litres containing 16.2 g of $Ca(HCO_3)_2$ per 100 litre is

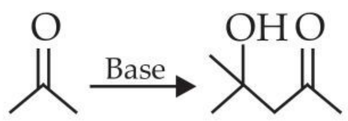
(a) 1.11 kg (b) 2.22 kg

(c) 3.33 kg (d) 4.44 kg

11. Which one of the following is hydride transfer reaction?

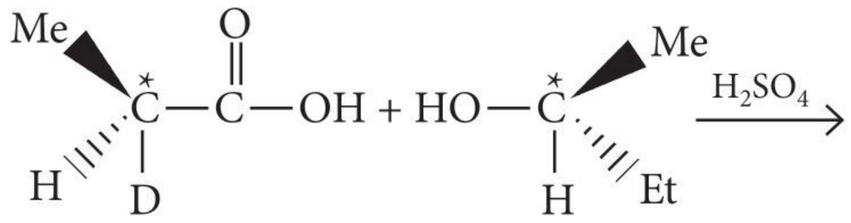
(a) 

(b) 

(c) 

(d) 

12. The major product (ester) of the following reaction is



(a) a single stereoisomer (optically active)
(b) a mixture of diastereomers (both optically active)
(c) a racemic mixture (optically inactive)
(d) a mixture of four stereoisomers (two racemic mixtures).

13. Out of vanadium (V), chromium (Cr), manganese (Mn) and iron (Fe), which one is expected to have the highest second ionisation enthalpy?
(a) V (b) Cr (c) Mn (d) Fe

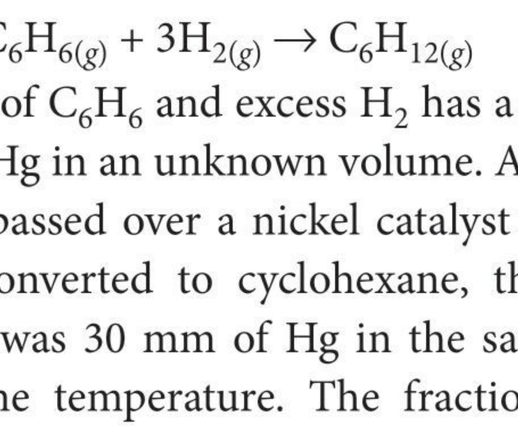
14. Which of the following is an inter-pseudohalogen?
(a) HSCN (b) ICN (c) BrF_5 (d) C_2N_2

15. Gaseous benzene reacts with hydrogen gas in presence of a nickel catalyst to form gaseous cyclohexane according to the reaction,

$$C_6H_{6(g)} + 3H_{2(g)} \rightarrow C_6H_{12(g)}$$

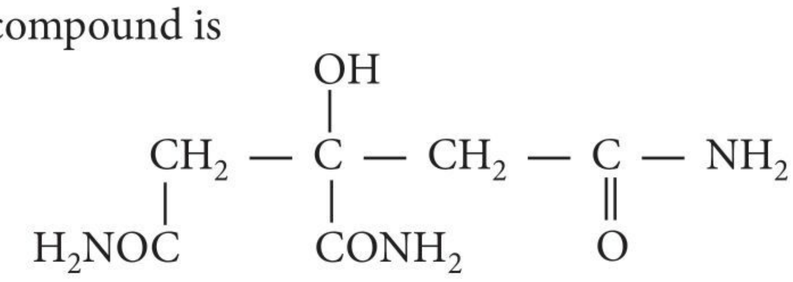
A mixture of C_6H_6 and excess H_2 has a pressure of 60 mm of Hg in an unknown volume. After the gas had been passed over a nickel catalyst and all the benzene converted to cyclohexane, the pressure of the gas was 30 mm of Hg in the same volume at the same temperature. The fraction of C_6H_6 (by volume) present in the original volume is
(a) 1/3 (b) 1/4
(c) 1/5 (d) 1/6

16. An ideal monoatomic gas follows the path *ABCD*. The work done during the complete cycle is



(a) $-PV$ (b) $-2PV$ (c) $-\frac{1}{2}PV$ (d) zero.

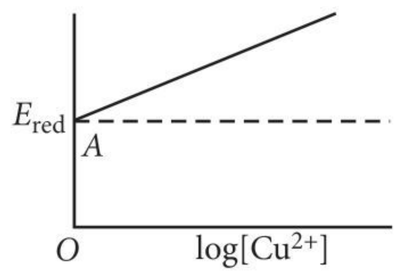
17. The correct systematic IUPAC name of the given compound is



(a) 3-Carbamoyl-3-hydroxybutanediamide
(b) 2-Hydroxypropane-1, 2, 3-tricarbamoyl
(c) 2-Hydroxypropane-1, 2, 3-tricarboxamide
(d) 2-Bis(carbamoyl)-2-hydroxyethanamide.

18. Some properties of the two species, NO_3^- and H_3O^+ are described below. Which one of them is correct?
(a) Dissimilar in hybridisation for the central atom with different structures.
(b) Isostructural with same hybridisation for the central atom.
(c) Isostructural with different hybridisation for the central atom.
(d) Similar in hybridisation for the central atom with different structures.

19. For the reaction, $Cu^{2+} + 2e^- \rightarrow Cu$; $\log[Cu^{2+}]$ *vs* E graph is of type as shown in figure, where $OA = 0.34$ V, then electrode potential of the half-cell of $Cu|Cu^{2+}$ (0.1 M) will be



(a) $-0.34 + \frac{0.059}{2}$ V (b) 0.34 + 0.059 V
(c) 0.34 V (d) none of these.

20. Allylic bromination of an olefin is
(a) nucleophilic substitution
(b) electrophilic substitution
(c) free radical substitution
(d) electrophilic addition.

21. Nodal planes of π-bond(s) in $CH_2{=}C{=}C{=}CH_2$ are located as
(a) all are in molecular plane
(b) two in molecular plane and one in a plane perpendicular to molecular plane which contains C — C σ-bond
(c) one in molecular plane and two in a plane perpendicular to molecular plane which contains C — C σ-bonds
(d) two in molecular plane and one in a plane perpendicular to molecular plane which bisects C — C σ-bonds.

22. In a first order reaction, the initial amount of a substance becomes 1/3 in 100 seconds. How much time will be taken to reduce the concentration to 1/9 of the initial concentration?
(a) 200 sec (b) 100 sec (c) 50 sec (d) 400 sec

23. Match the column I with column II and mark the appropriate choice.

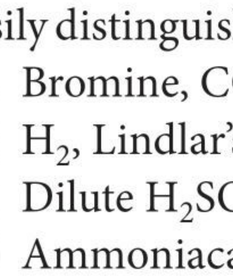
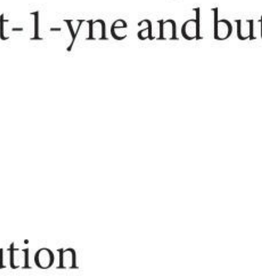
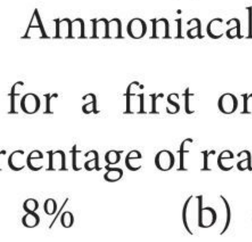
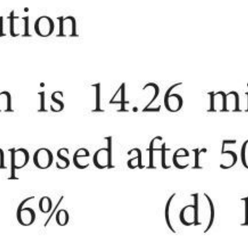
Column I		Column II	
(A)	$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O$	(i)	$\Delta_{sol}H°$
(B)	$H_{2(g)} \rightarrow 2H_{(g)}$	(ii)	$\Delta_{lattice}H°$
(C)	$NaCl_{(s)} \rightarrow Na^+_{(g)} + Cl^-_{(g)}$	(iii)	$\Delta_cH°$
(D)	$NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$	(iv)	$\Delta_{bond}H°$

(a) (A) → (iv), (B) → (iii), (C) → (i), (D) → (ii)
(b) (A) → (ii), (B) → (i), (C) → (iv), (D) → (iii)
(c) (A) → (i), (B) → (ii), (C) → (iii), (D) → (iv)
(d) (A) → (iii), (B) → (iv), (C) → (ii), (D) → (i)

24. A galvanic cell is constructed as follows. A half-cell consists of a platinum wire immersed in a solution containing 1.0 M of Sn^{2+} and 1.0 M of Sn^{4+}, and another half-cell has a thallium rod immersed in a 1.0 M solution of Tl^+.
Given : $Sn^{4+}_{(aq)} + 2e^- \longrightarrow Sn^{2+}_{(aq)}$; $E° = +0.13$ V
and $Tl^+_{(aq)} + e^- \longrightarrow Tl_{(s)}$; $E° = -0.34$ V,
What is the cell voltage if the Tl^+ concentration is increased tenfold?
(a) 0.411 V (b) 4.101 V (c) 0.492 V (d) 0.222 V

25. $H_2C_2O_4 \xrightarrow{\Delta}$ gas (*A*) + gas (*B*) + liquid (*C*).
Gas (*A*) burns with a blue flame and is oxidized to gas (*B*).
Gas (*B*) + $NH_3 \longrightarrow$ (*D*) $\xrightarrow{\Delta}$ (*E*)
A, *B*, *C* and *E* are respectively
(a) CO_2, CO, H_2O, $HCONH_2$
(b) CO, CO_2, H_2O, $HCONH_2$
(c) CO, CO_2, H_2O, NH_2CONH_2
(d) CO, CO_2, H_2O, NH_4OH

26. Acetone and chloroform form a non-ideal solution. If 116 g of acetone is mixed with 239 g of chloroform and their vapour pressures in pure state at 298 K are 360 torr and 300 torr respectively, then what would be vapour pressure of the above solution at 298 K?
(a) 330 torr (b) 350 torr
(c) 250 torr (d) 370 torr

27. Ethyl ester $\xrightarrow[\text{Excess}]{CH_3MgBr} P$
The product *P* is
(a) 
(b) 
(c) 
(d) 

28. An alcohol (*A*) on dehydration gives (*B*) which adds bromine molecule to give (*C*). (*C*) on heating with sodamide gives (*D*) which on hydration in the presence of Hg^{2+}/H_2SO_4 gives (*E*). (*E*) is also obtained on dry distillation of calcium salt of acetic acid. (*A*) is
(a) butan-1-ol (b) propan-2-ol
(c) propan-1-ol (d) butan-2-ol.

29. Identify a reagent from the following which can easily distinguish between but-1-yne and but-2-yne.
(a) Bromine, CCl_4
(b) H_2, Lindlar's catalyst
(c) Dilute H_2SO_4, $HgSO_4$
(d) Ammoniacal Cu_2Cl_2 solution

30. $t_{½}$ for a first order reaction is 14.26 mins. The percentage of reactant decomposed after 50 s is
(a) 8% (b) 4% (c) 6% (d) 10.2%

31. Identify the statement which is correct w.r.t. surface phenomenon.
(a) Osmotic pressure of rubber sol will be same as that of sucrose solution having same mass mixed in same mass of H_2O.
(b) A gas may show physisorption at low temperature and chemisorption at higher temperatures.
(c) Soap sol of sodium palmitate will be coagulated near cathode on electrophoresis.
(d) Gold sol on mixing with starch sol causes stabilisation of starch sol.

32. Vitamin C (ascorbic acid) contains 40.92% C, 4.58% H and 54.50% O by mass. If molecular weight of ascorbic acid is 176 g mol^{-1}, what is the molecular formula?
(a) $C_3H_2O_3$ (b) C_4H_3O
(c) $C_6H_8O_6$ (d) $C_3H_4O_3$

33. In which of the following pairs the radius of the second species is greater than that of the first?

(a) Na, Mg (b) O^{2-}, N^{3-}

(c) Li^+, Be^{2+} (d) Ba^{2+}, Sr^{2+}

34. $P \xrightarrow[2.\ H_3O^+]{1.\ CH_3MgBr} R \xrightarrow[2.\ \Delta]{1.\ dil.\ NaOH}$ 4-methylpent-3-en-2-one

P is

(a) propanone (b) ethanamine

(c) ethanenitrile (d) ethanal.

35. The plot of $\log_{10}K$ vs $1/T$ leads to a straight line having intercept equal to

(a) $\Delta G°$ (b) $\dfrac{\Delta G°}{2.303R}$

(c) $\dfrac{\Delta S°}{2.303R}$ (d) $\dfrac{\Delta H°}{2.303R}$

36. A student is given a solution which may contain carbonate ions. She decides to add aqueous barium nitrate to the solution first, followed by dilute nitric acid. Choose the correct statements about her experiment.

(a) Dilute nitric acid will react with both soluble and insoluble carbonates.

(b) The above procedure is strictly to test the presence of sulphate ions only.

(c) The unknown compound will only react with the dilute nitric acid and not with the barium nitrate.

(d) The acid must be added directly to the solution to test the presence of carbonates.

37. Match the list-I with list-II and pick the correct answer.

List-I	List-II
(A) $[Ag(CN)_2]^-$	1. Square planar and 1.73 B.M.
(B) $[Cu(CN)_4]^{3-}$	2. Linear and zero
(C) $[Cu(CN)_6]^{4-}$	3. Octahedral and zero
(D) $[Cu(NH_3)_4]^{2+}$	4. Tetrahedral and zero
(E) $[Fe(CN)_6]^{4-}$	5. Octahedral and 1.73 B.M.

(a) A – 2, B – 4, C – 5, D – 1, E – 3

(b) A – 5, B – 4, C – 1, D – 3, E – 2

(c) A – 1, B – 3, C – 4, D – 2, E – 5

(d) A – 2, B – 5, C – 4, D – 1, E – 3

38. Match list-I (compounds) with list-II (uses) and select the correct answer.

List-I	List-II
i. Acetyl salicylic acid	(A) Insecticide
ii. DDT	(B) Drug
iii. Naphthalene	(C) Moth repelling
iv. Carbon tetrachloride	(D) Fire extinguisher
	(E) Refrigerant

(a) i-(B), ii-(A), iii-(C), iv-(D)

(b) i-(E), ii-(C), iii-(D), iv-(A)

(c) i-(B), ii-(C), iii-(D), iv-(A)

(d) i-(E), ii-(A), iii-(C), iv-(D)

39. Which of the following complexes has magnetic moment of 2.83 B.M.?

(a) $[Ni(NH_3)_6]^{2+}$ (b) $[Ni(CN)_4]^{2-}$

(c) $TiCl_4$ (d) $[CoCl_6]^{3-}$

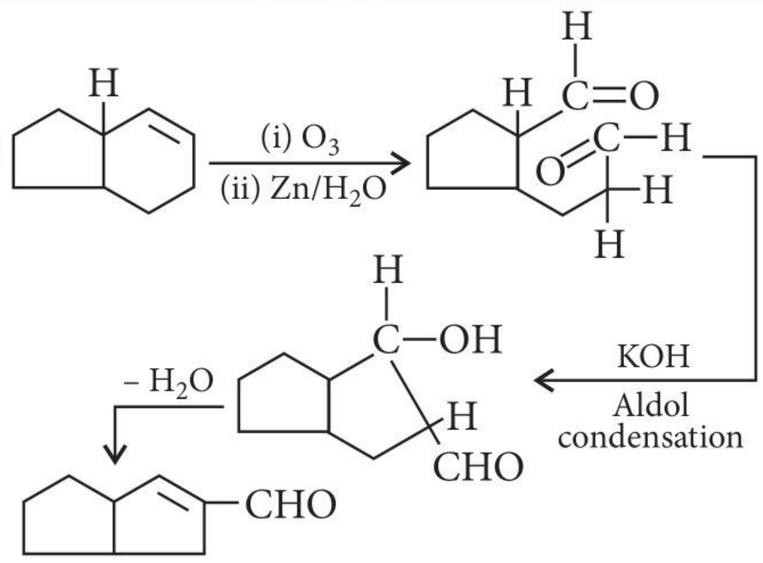
40. Amoxicillin is semi-synthetic modification of

(a) penicillin (b) streptomycin

(c) tetracycline (d) chloramphenicol.

SOLUTIONS

1. (b):



2. (b): The photon capable of removing an electron from first Bohr's orbit must possess energy

$= 13.6\ eV = 13.6 \times 1.602 \times 10^{-19}\ J$

$= 21.787 \times 10^{-19}\ J$

$\because \quad E = \dfrac{hc}{\lambda}$

$$21.787 \times 10^{-19} = \frac{6.625\times10^{-34}\times3.0\times10^{8}}{\lambda}$$

$\therefore \quad \lambda = 912.24 \times 10^{-10}\ m = 912.24\ Å$

This is longest λ because a photon having λ higher than this will possess energy lesser than required, as $E \propto \dfrac{1}{\lambda}$.

3. (c): $H_3A + OH^- \longrightarrow H_2A^- + H_2O$ ...K_1

$\Rightarrow$ 1st equivalence point

$H_2A^- + OH^- \longrightarrow HA^{2-} + H_2O$ ...K_2

$\Rightarrow$ 2nd equivalence point

$HA^{2-} + OH^- \longrightarrow A^{3-} + H_2O$ ...K_3

At 2nd equivalent point the species present in appreciable concentration is HA^{2-} (amphiprotic anion).

So, the pH $= \frac{1}{2}(pK_2 + pK_3) = 10 \quad \Rightarrow \quad [H^+] = 10^{-10}$

$$K_1 \times K_2 \times K_3 = \frac{[H^+]^3 \times [A^{3-}]}{[H_3A]}$$

$$\Rightarrow \quad \frac{[H_3A]}{[A^{3-}]} = \frac{[H^+]^3}{K_1 \times K_2 \times K_3}$$

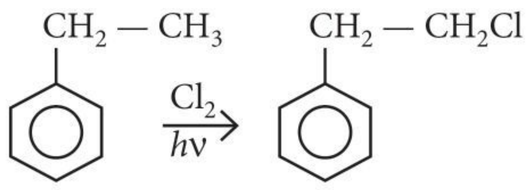
$$= \frac{10^{-30}}{(7.5\times10^{-4})\times10^{-8}\times10^{-12}} \simeq 10^{-7}$$

4. (c) : Natural rubber is *cis*-polyisoprene.

5. (d): In terms of edge length a

$$x = \frac{\sqrt{2}}{2}a\,;\; y = \frac{a}{2}\,;\; z = \frac{\sqrt{3}a}{4}$$

6. (a) :



7. (a) : Since, A and A_2 are two states in gaseous phase having their weight ratio 50%, *i.e.*, 1 : 1

$\therefore$ Moles of $A = \frac{96}{2}\times\frac{1}{48} = 1$;

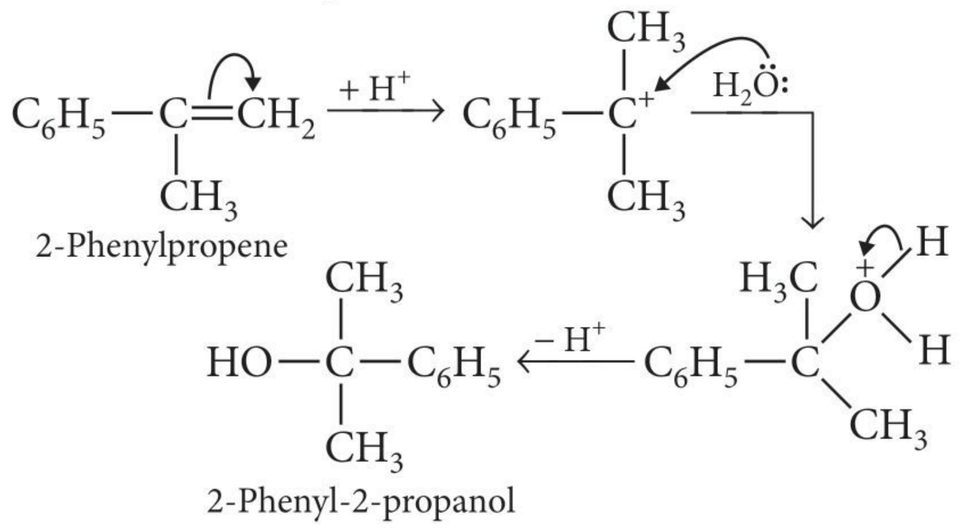
Moles of $A_2 = \frac{96}{2}\times\frac{1}{96} = \frac{1}{2}$

$\therefore$ Total moles of A and A_2 are $= 1 + \frac{1}{2} = \frac{3}{2}$

$PV = nRT$

$$P \times 33.6 = \frac{3}{2}\times 0.0821 \times 546 = 2 \text{ atm}$$

8. (c) : The reaction proceeds via carbocation formation.



9. (c) : For a protective colloid, lesser the value of gold number better is the protective power.
Thus, the correct order of protective power of A, B, C and D is
Protective power : $(A) < (C) < (B) < (D)$
Gold number : $0.50 > 0.10 > 0.01 > 0.005$

10. (d): Amount of $Ca(HCO_3)_2$ in 60,000 litres of water

$$= \frac{16.2\times60{,}000}{100} = 9720 \text{ g}$$

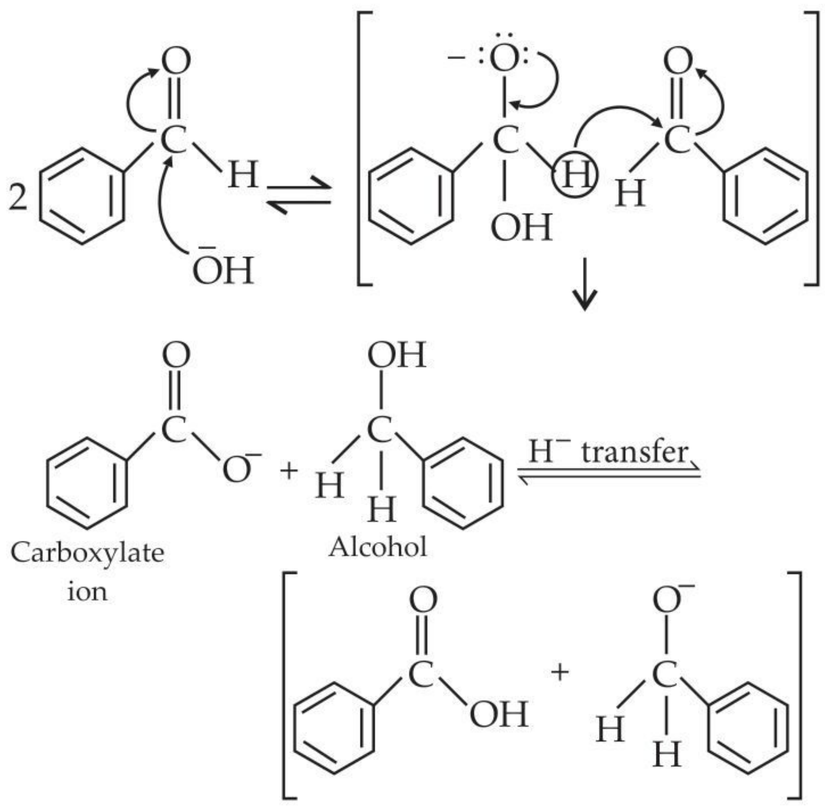
$$= \frac{9720}{162} = 60 \text{ moles } (\because \text{ mol. wt. of } Ca(HCO_3)_2 = 162)$$

$$Ca(OH)_2 + Ca(HCO_3)_2 \rightarrow 2CaCO_3\downarrow + 2H_2O$$

1 mole 1mole

Amount of $Ca(OH)_2$ required = 60 moles = 60×74 g
$= 4440$ g $= 4.44$ kg
($\because$ mol. wt. of $Ca(OH)_2 = 74$)

11. (a) : Aldehydes like benzaldehyde, having lack of α-hydrogen atoms on treatment with NaOH or KOH, are converted to equal amounts of the corresponding carboxylate anion and alcohol *via* Cannizzaro reaction.



12. (d)

13. (b) : The electronic configurations of these elements are
V ($Z = 23$) : $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^3\,4s^2$
Cr ($Z = 24$): $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^5\,4s^1$
Mn ($Z = 25$): $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^5\,4s^2$
Fe ($Z = 26$): $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^6\,4s^2$
In the case of chromium, the second electron has to be removed from the half-filled d-shell which is more stable.

14. (b): F_2, Cl_2, Br_2 and I_2 – Halogen
ICl, ICl_3, etc. – Interhalogen
CN^-, SCN^-, OCN^- – Pseudohalogen
ICN – Inter-pseudohalogen

15. (d): Let, initial pressure of $C_6H_{6(g)} = P_1$ mm and that of $H_{2(g)} = P_2$ mm

$\therefore \quad P_1 + P_2 = 60$ mm ...(i)

After the reaction,
pressure of $C_6H_{6(g)} = 0$ (as all has reacted)
pressure of $H_{2(g)} = P_2 - 3P_1$
pressure of $C_6H_{12(g)} = P_1$
Total pressure = $P_2 - 3P_1 + P_1 = 30$ mm
or $P_2 - 2P_1 = 30$ mm ...(ii)
Solving (i) and (ii), we get
$P_1 = 10$ mm, $P_2 = 50$ mm
Fraction of C_6H_6 by volume = Fraction of moles
= Fraction of pressure $= \frac{10}{60} = \frac{1}{6}$

16. (a) : Net work done during the complete cycle is equal to area under the cycle (–ve if cycle is clockwise, *i.e.*, work done by the gas and +ve when cycle is anticlockwise, *i.e.*, work done on the gas).
$w = -P \times V = -(2P - P) \times (2V - V) = -PV$

17. (c)

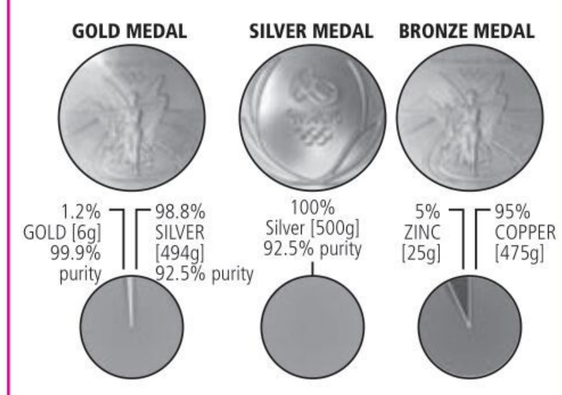
18. (a) : No. of electron pairs at the central atom = no. of atoms bonded to it + 1/2[group number of central atom – valency of the central atom ± no. of electrons]
No. of electron pairs at the central atom
in $NO_3^- = 3 + \frac{1}{2}[5 - 6 + 1] = 3$ (sp^2 hybridisation).
No. of electron pairs at the central atom in
in $H_3O^+ = 3 + \frac{1}{2}[6 - 3 - 1] = 4$ (sp^3 hybridisation).

19. (a) : $E_{Cu/Cu^{2+}} = E^\circ_{Cu/Cu^{2+}} - \frac{0.059}{2}\log[Cu^{2+}]$
If $\log[Cu^{2+}] = 0$ *i.e.* $[Cu^{2+}] = 1$
then $E_{Cu/Cu^{2+}} = E^\circ_{Cu/Cu^{2+}}$
$OA = 0.34\ V = E^\circ_{Cu^{2+}/Cu} = -E^\circ_{Cu/Cu^{2+}}$
$\Rightarrow \quad E^\circ_{Cu/Cu^{2+}} = -0.34\ V$
Now, $E_{Cu/Cu^{2+}} = -0.34 - \frac{0.059}{2}\log 0.1$
$= -0.34 + \frac{0.059}{2}\ V$

20. (c) **21. (b)**

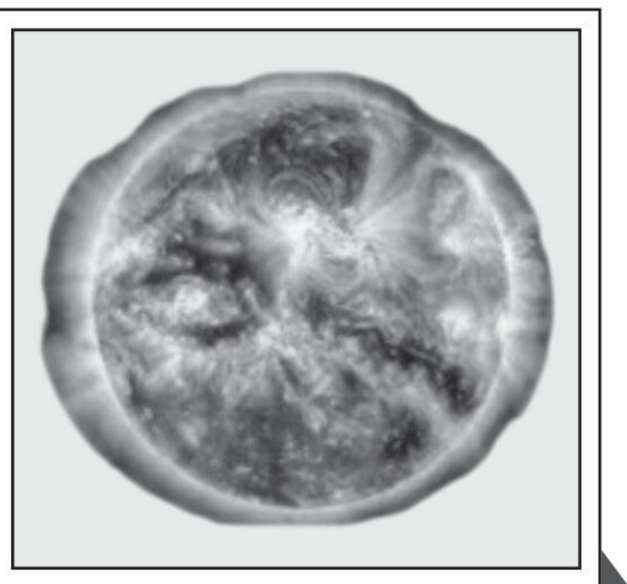
22. (a) : For the first order reaction,
$k = \frac{2.303}{t}\log_{10}\frac{a}{(a-x)}$
Let the initial amount is a mol L^{-1}, then
after $t = 100$ seconds, $(a - x) = \frac{a}{3}$ mol L^{-1}

3 Amazing Facts You Must Know



What Are Olympic Gold Medals Made Of?

The gold and silver medals are both made of silver. The gold medals are then coated with gold. Each Olympic gold medal is made up of 210g of silver and is coated with 6g of 24 carat gold. The bronze medals are made of copper, zinc, tin, and a very small amount of silver.



How Does the Sun Burn without Oxygen?

Sun is made mostly of hydrogen (besides helium), which is a highly flammable gas. But, as in the case of planet Uranus, there is no oxygen at the Sun.

In classical terms, we need oxygen for a fire to burn. But the Sun is not actually on fire. Its heat and light come from nuclear fusion reactions, mainly combining hydrogen to make helium. This process does not require oxygen to happen.

Why Does High Air Humidity Make it Feel Hotter?

The natural mechanism of our body to cool itself down is sweating. Evaporation of sweat from our skin takes up energy from our bodies, cooling ourselves down. The more water there is already in the air (higher humidity), the more difficult this evaporation process take place. Therefore, higher concentration of water in air, makes us feel hotter because we cannot cool down efficiently.

$$\therefore \quad k = \frac{2.303}{100}\log_{10}\frac{a}{a/3} = \frac{2.303}{100}\log_{10} 3$$

$$= 10.988 \times 10^{-3}\ \text{sec}^{-1}$$

Let the time required to reduce the concentration to $a/9$ is t_1, then

$$t_1 = \frac{2.303}{10.988\times10^{-3}}\log_{10}\frac{a}{a/9} = 200\ \text{sec}$$

23. (d): (A) : $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O$; shows combustion reaction

(B) : $H_{2(g)} \rightarrow 2H_{(g)}$; shows bond dissociation

(C) : $NaCl_{(s)} \rightarrow Na^+_{(g)} + Cl^-_{(g)}$; shows dissociation of NaCl

(D) : $NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$; shows dissolution of NaCl

24. (a): The cell is represented as

$Tl_{(s)} \mid Tl^+(1.0\ M) \parallel Sn^{4+}(1.0\ M), Sn^{2+}(1.0\ M) \mid Pt$

The cell reactions are $(Tl_{(s)} \longrightarrow Tl^+ + e^-) \times 2$

$Sn^{4+} + 2e^- \longrightarrow Sn^{2+}$

Overall reaction : $2Tl_{(s)} + Sn^{4+} \longrightarrow 2Tl^+ + Sn^{2+}$

$$E = (E^\circ_{\text{Right}} - E^\circ_{\text{Left}}) - \frac{0.0592}{2}\log\frac{[Tl^+]^2[Sn^{2+}]}{[Sn^{4+}]}$$

$= 0.47\ V - 0.0296 \log (10)^2 = 0.411\ V$

[$\because$ Tl concentration increases tenfold]

25. (c) : $H_2C_2O_4 \xrightarrow{\Delta} \underset{A}{CO} + \underset{B}{CO_2} + \underset{C}{H_2O}$

$2CO + O_2 \longrightarrow 2CO_2$

$\underset{B}{CO_2} + 2NH_3 \longrightarrow \underset{D}{NH_2COONH_4} \xrightarrow{\Delta}$

$NH_2CONH_2 + H_2O$

E

26. (c) : $n_{\text{Acetone}} = \frac{116}{58} = 2; n_{\text{Chloroform}} = \frac{239}{119.5} = 2$

$P_{\text{Ideal}} = \frac{1}{2}\times 360 + \frac{1}{2}\times 300 = 330\ \text{torr}$

$P_{\text{Obs}} < P_{\text{Ideal}}$ (–ve deviation solution)

Only (c) option satisfies.

27. (a) : $\underset{\text{Ethyl ester}}{H_3C - \overset{\overset{O}{\|}}{C} - OC_2H_5} + CH_3MgBr \longrightarrow$

$$\xrightarrow[-Mg(OC_2H_5)Br]{H^+/H_2O} H_3C - \overset{\overset{O}{\|}}{C} - CH_3$$

$$\xrightarrow[\text{(ii) } H^+/H_2O]{\text{(i) } CH_3MgBr} H_3C - \underset{\underset{CH_3}{|}}{\overset{\overset{OH}{|}}{C}} - CH_3 + Mg(OH)Br$$

28. (b): The overall reaction can be summarised as :

$$\underset{(A)}{\text{Alcohol}} \xrightarrow[-H_2O]{} B \xrightarrow{Br_2} C \xrightarrow{NaNH_2/\Delta} D$$

$$(CH_3COO)_2Ca \xrightarrow{\Delta} E \xleftarrow{Hg^{2+}/H_2SO_4} D$$

By given hint, it is clear that E is acetone hence overall sequence of reactions will be

$$\underset{\underset{\text{Propan-2-ol}}{(A)}}{CH_3\underset{\underset{OH}{|}}{CH}CH_3} \xrightarrow[-H_2O]{H^+/\Delta} \underset{(B)}{CH_3CH=CH_2} \xrightarrow{Br_2} \underset{\underset{(C)}{Br\ Br}}{CH_3\underset{|}{CH}\underset{|}{CH_2}} \xrightarrow{NaNH_2/\Delta}$$

$$(CH_3COO)_2Ca \xrightarrow{\Delta} \underset{(D)}{CH_3\overset{\overset{O}{\|}}{C}CH_3} \xleftarrow{Hg^{2+}/H_2SO_4} CH_3C\equiv CH$$

29. (d): 1-Alkynes react with ammoniacal solution of Cu_2Cl_2 to form red precipitate of the corresponding copper alkynides.

But-1-yne reacts with ammoniacal Cu_2Cl_2 as follows :

$$CH_3-CH_2-C\equiv CH + Cu(NH_3)_2Cl \longrightarrow \underset{\text{red precipitate}}{CH_3-CH_2-C\equiv C^-Cu^+}$$

But, but-2-yne does not react with this reagent.

30. (b): $k = \frac{0.693}{t_{1/2}} = \frac{0.693}{14.26\times 60}\ \text{sec}^{-1}$

$k = \frac{2.303}{t}\log\frac{a}{a-x}$ (for first order reaction)

$$\frac{0.693}{14.26\times 60} = \frac{2.303}{50}\log\frac{a}{a-x}$$

$$\log\frac{a}{a-x} = \frac{0.693\times 50}{14.26\times 60\times 2.303} = 0.0175$$

$$\frac{a}{a-x} = 1.041 \text{ or } \frac{a-x}{a} = 0.96 \text{ or } 1-\frac{x}{a} = 0.96$$

$$\frac{x}{a} = 0.04 = 4\%$$

31. (b)

32. (c) :

Element	Percentage	Atomic mass	Relative number of atoms	Simplest ratio
C	40.92	12	$\frac{40.92}{12} = 3.41$	$\frac{3.41}{3.41} = 1 \times 3 = 3$
H	4.58	1	$\frac{4.58}{1} = 4.58$	$\frac{4.58}{3.41} = 1.34 \times 3 = 4$
O	54.50	16	$\frac{54.50}{16} = 3.41$	$\frac{3.41}{3.41} = 1 \times 3 = 3$

Hence, empirical formula is $C_3H_4O_3$

Empirical formula weight = 36 + 4 + 48 = 88

$$n = \frac{\text{Molecular weight}}{\text{Empirical formula weight}} = \frac{176}{88} = 2$$

Thus, molecular formula = (Empirical formula) × n
= $(C_3H_4O_3) \times 2 = C_6H_8O_6$

33. (b): N^{3-} and O^{2-} both are isoelectronic but differ in the charge possessed by them. As the nuclear charge decreases from O to N, the electrons are held less and less tightly by the nucleus. Hence, the ionic size increases from O^{2-} to N^{3-}.

34. (c) :

$$\underset{\text{Ethanenitrile 'P'}}{H_3C-C\equiv N} \xrightarrow[H_3O^+]{CH_3MgBr} \underset{\text{Acetone (2 moles)}}{CH_3COCH_3}$$

$$\underset{\text{Diacetone alcohol (Aldol)}}{(CH_3)_2\overset{\overset{OH}{|}}{C}-CH_2COCH_3} \xleftarrow[\text{(Aldol condensation)}]{\text{1. dil. NaOH}}$$

$$\xrightarrow[-2H_2O]{\text{2. Heat, } H^+} \underset{\text{4-Methylpent-3-ene-2-one (Mesityl oxide)}}{(CH_3)_2C=CHCOCH_3}$$

35. (c) : $\Delta G^\circ = -2.303\, RT \log_{10} K$

$$\log_{10} K = -\frac{\Delta G^\circ}{2.303\,RT} = -\frac{(\Delta H^\circ - T\Delta S^\circ)}{2.303\,RT}$$

$$= -\frac{\Delta H^\circ}{2.303\,RT} + \frac{\Delta S^\circ}{2.303\,R}$$

Comparing it with straight line equation,
$y = mx + c$

we get, slope $(m) = \frac{-\Delta H^\circ}{2.303\,R}$

and intercept $(c) = \frac{\Delta S^\circ}{2.303\,R}$

36. (a) : When barium nitrate is added, a white precipitate of barium carbonate is formed. This precipitate reacts with dilute nitric acid added, to produce effervescence with the liberation of CO_2 gas.

$Ba^{2+}_{(aq)} + CO^{2-}_{3(aq)} \longrightarrow BaCO_{3(s)}$

$BaCO_{3(s)} + 2H^+_{(aq)} \longrightarrow Ba^{2+}_{(aq)} + CO_{2(g)} + H_2O_{(l)}$

37. (a) : $[Ag(CN)_2]^-$ is linear (sp) with no unpaired electron hence, magnetic moment = 0

$[Cu(CN)_4]^{3-}$ is tetrahedral (sp^3) with no unpaired electron hence, magnetic moment = 0

$[Cu(CN)_6]^{4-}$ is octahedral (sp^3d^2) with one unpaired electron hence, magnetic moment = 1.73 B.M.

$[Cu(NH_3)_4]^{2+}$ is square planar (dsp^2) with one unpaired electron hence, magnetic moment = 1.73 B.M.

$[Fe(CN)_6]^{4-}$ is octahedral (d^2sp^3) with no unpaired electron hence, magnetic moment = 0.

38. (a) : Acetyl salicylic acid - Drug
DDT - Insecticide
Naphthalene - Moth repelling
Carbon tetrachloride - Fire extinguisher

39. (a) : 2.83 B.M. implies two unpaired electrons according to the expression, $\mu = \sqrt{n(n+2)}$ B.M. The species Ni^{2+}, Ni^{2+}, Ti^{4+} and Co^{3+} in the given complexes have $3d^8$, $3d^8$, $3d^0$, and $3d^6$ electronic configurations, respectively. CN being a strong field ligand causes pairing of electrons thus, $[Ni(CN)_4]^{2-}$ has zero unpaired electrons with dsp^2 hybridisation, while NH_3 being a weak field ligand, does not cause pairing of electrons thus, $[Ni(NH_3)_6]^{2+}$ has two unpaired electrons and 2.83 B.M. magnetic moment.

40. (a) : Amoxicillin (an antibiotic) is semi-synthetic modification of penicillin.

◈◈

MONTHLY TEST DRIVE CLASS XI ANSWER KEY

1.	(b)	**2.**	(b)	**3.**	(a)	**4.**	(c)	**5.**	(b)
6.	(a)	**7.**	(b)	**8.**	(c)	**9.**	(d)	**10.**	(c)
11.	(c)	**12.**	(a)	**13.**	(c)	**14.**	(b)	**15.**	(a)
16.	(c)	**17.**	(a)	**18.**	(d)	**19.**	(b)	**20.**	(c,d)
21.	(b,d)	**22.**	(a,c)	**23.**	(a,b)	**24.**	(1)	**25.**	(2)
26.	(4)	**27.**	(d)	**28.**	(d)	**29.**	(c)	**30.**	(a)

CONCEPT MAP

HALOALKANES AND HALOARENES

1 Classification

On the basis of number halogen atoms

- Monohalogen, *e.g.*, RCH_2X
- Dihalogen, *e.g.*, $X-CH_2CH_2-X$
- Trihalogen, *e.g.*, CHX_3

Compounds containing sp^2 C—X bond

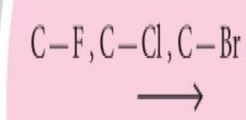
- Vinylic halide
- Aryl halide

Compounds containing sp^3 C—X bond

- Allylic halide
- Benzylic halide

Haloalkanes $R-X$

2 Nature of C—X Bond



$C-F, C-Cl, C-Br, C-I \longrightarrow$

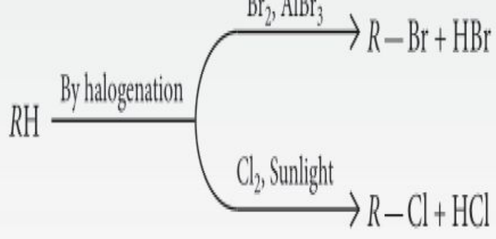
Size of halogen atoms increases

C—X bond length increases

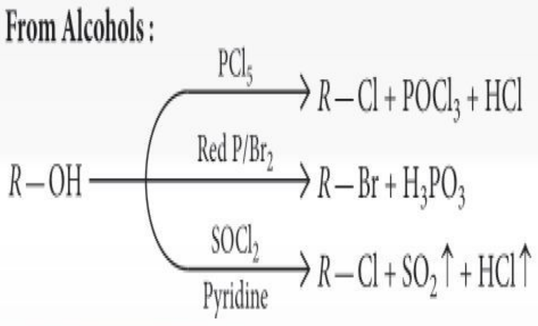
Bond enthalpy decreases

3 Methods of Preparation

♦ **From Alkanes :**



♦ **From Alcohols :**



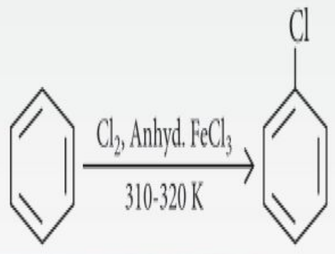
♦ **Finkelstein Reaction :** $R-X + NaI \xrightarrow{\text{Dry acetone}} R-I + NaX$

♦ **Swarts Reaction :** $RBr + AgF \longrightarrow R-F + AgBr$

♦ **Hunsdiecker Reaction :**

$RCOOAg + Br_2 \xrightarrow{CCl_4/\text{Reflux}} R-Br + CO_2 + AgBr$

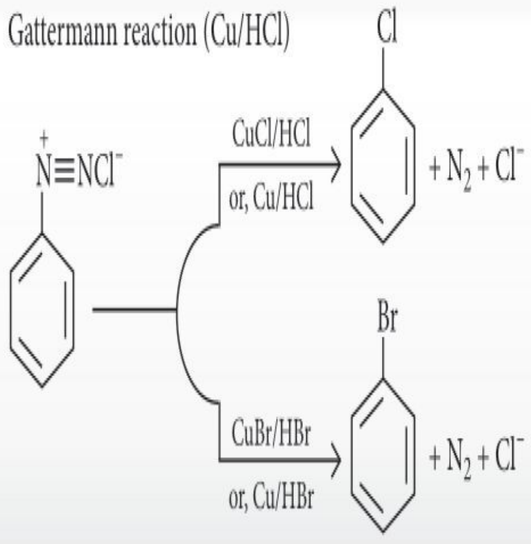
♦ **Direct halogenation of aromatic hydrocarbons :**



♦ **From diazonium salts :**

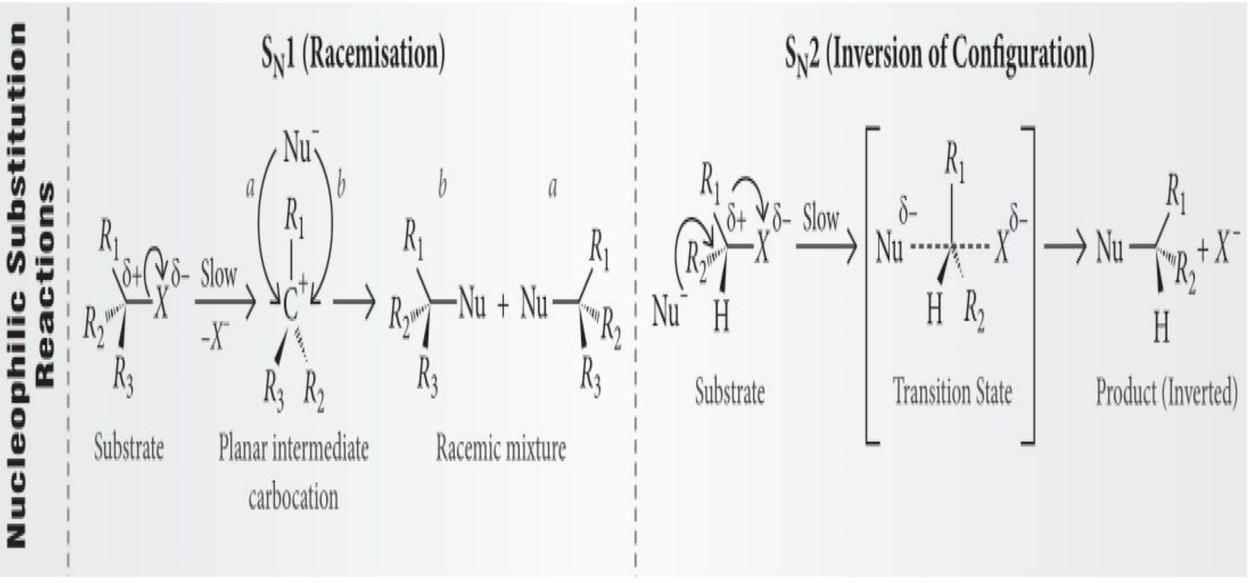
Sandmeyer's reaction (CuCl/HCl) and

Gattermann reaction (Cu/HCl)



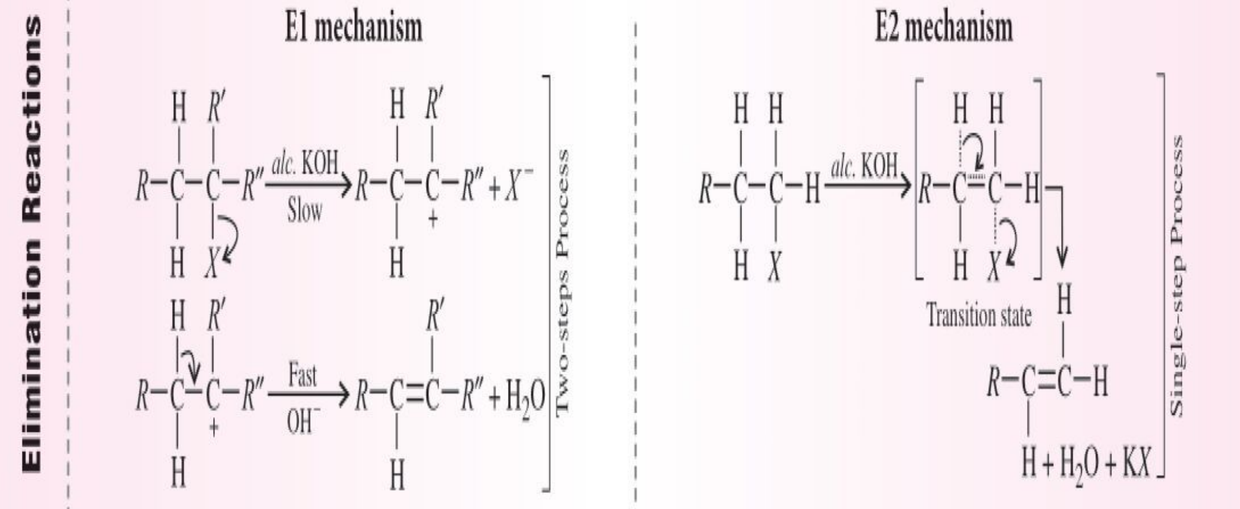
4 Chemical Properties

Nucleophilic Substitution Reactions



Elimination Reactions

Alkyl halides undergo β-elimination reaction in the presence of potassium hydroxide in ethanol (high temperature) to yield alkenes.

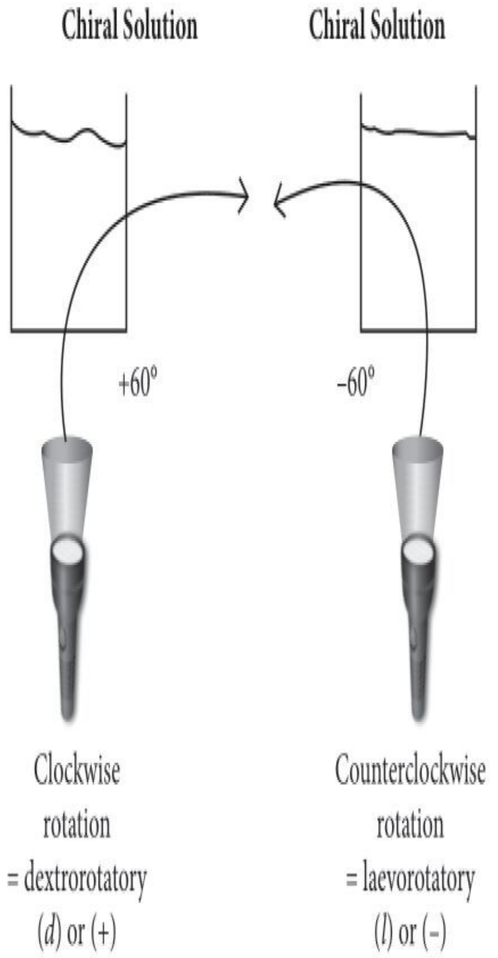


5 Stereochemistry

Optical Activity

Plane polarised light produced by passing ordinary light through nicol prism is rotated when it is passed through the solutions of certain compounds. Such compounds are called optically active compounds.

Chirality : The objects which are non-superimposable on their mirror images are said to be chiral.



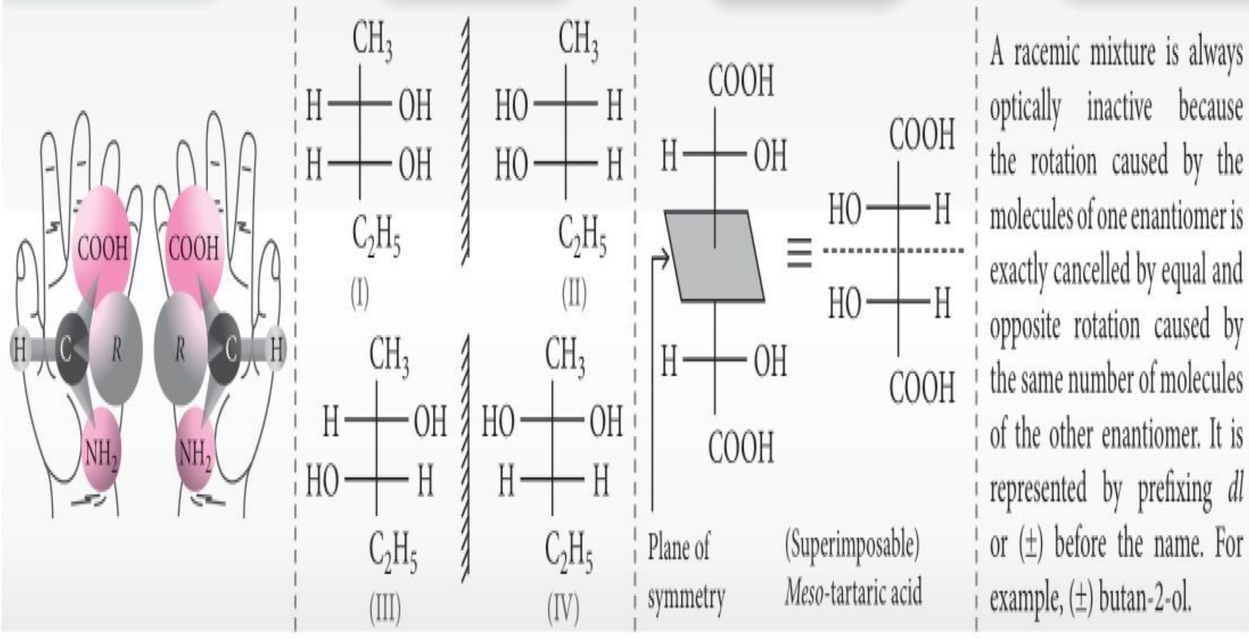
The direction and magnitude of rotation must be determined experimentally. There is no correlation between (*R*) and (*S*) configuration and the direction of rotation.

Enantiomers : Compounds having non-superimposable mirror images with same physical and chemical properties.

Diastereomers : Compounds which are not mirror images (I and III, II and IV) of each other with different physical properties but same chemical properties.

Meso compounds : These are optically inactive compounds as there exists a plane of symmetry which divides the molecule into two identical halves.

Racemic mixture : A mixture of equal amounts of two enantiomers is called *racemic mixture* or *racemic modification*.



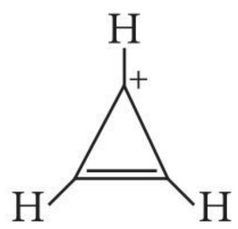
A racemic mixture is always optically inactive because the rotation caused by the molecules of one enantiomer is exactly cancelled by equal and opposite rotation caused by the same number of molecules of the other enantiomer. It is represented by prefixing *dl* or (±) before the name. For example, (±) butan-2-ol.

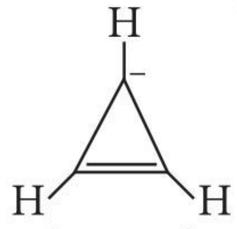
GET SET GO for NEET

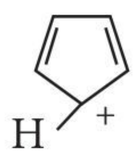
with exclusive and brain storming MCQs

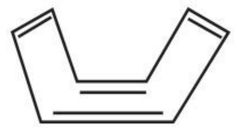
Practicing these MCQs help to strengthen your concepts and give you extra edge in your NEET preparation

1. Which of the following is an aromatic compound?

(a) 

(b) 

(c) 

(d) 

2. $Be_2C + 4H_2O \longrightarrow 2X + CH_4$

$X + 2HCl_{(aq)} \longrightarrow Y$

X and Y formed in the above two reactions are

(a) $BeCO_3$ and $Be(OH)_2$ respectively

(b) $Be(OH)_2$ and $BeCl_2$ respectively

(c) $Be(OH)_2$ and $[Be(OH)_4]Cl_2$ respectively

(d) $[Be(OH)_4]^{2-}$ and $BeCl_2$ respectively.

3. In the dehydration reaction,

$CH_3CONH_2 \xrightarrow{P_2O_5} CH_3C \equiv N$

the hybridisation state of carbon changes from

(a) sp^3 to sp^2 (b) sp to sp

(c) sp^2 to sp (d) sp to sp^3

4. Sewage containing organic waste should not be disposed in water bodies because it causes major water pollution. Fish in such a polluted water die because of

(a) large number of mosquitoes

(b) increase in the amount of dissolved oxygen

(c) decrease in the amount of dissolved oxygen in water

(d) decrease in concentration of radioactive substance in water.

5. The angular momentum of an electron in a given orbit is J, its kinetic energy will be

(a) $\frac{1}{2}\frac{J^2}{mr^2}$ (b) $\frac{Jv}{r}$

(c) $\frac{J^2}{2m}$ (d) $\frac{J^2}{2\pi}$

6. Which of the following statements is not correct about the given reaction?

$K_4[Fe(CN)_6] \xrightarrow{\text{Oxidation}} Fe^{3+} + CO_2 + NO_3^-$

(a) Fe is oxidised from Fe^{2+} to Fe^{3+}.

(b) Carbon is oxidised from C^{2+} to C^{4+}.

(c) N is oxidised from N^{3-} to N^{5+}.

(d) Carbon is not oxidised.

7. When x gram of carbon are heated with y gram of oxygen in a closed vessel, no solid residue is left behind. Which of the following statements is correct?

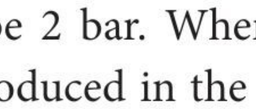
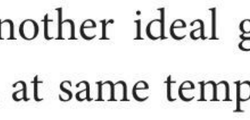
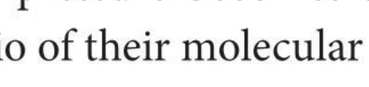
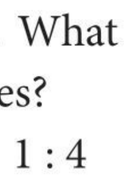
(a) y/x must lie between 1.33 and 2.67.
(b) y/x must be greater than or equal to 2.67.
(c) y/x must be less than or equal to 1.33
(d) y/x must be greater than or equal to 1.33.

8. Elements X, Y and Z have atomic numbers 19,37 and 55 respectively. Which of the following statements is true about them?
(a) Their ionisation potential would increase with increasing atomic number.
(b) Y would have an ionisation potential between those of X and Z.
(c) Z would have the highest ionisation potential.
(d) Y would have the highest ionisation potential.

9. Standard molar enthalpy of formation of CO_2 is equal to
(a) zero
(b) the standard molar enthalpy of combustion of carbon (diamond)
(c) the sum of standard molar enthalpies of combustion of gaseous carbon and of CO
(d) the standard molar enthalpy of combustion of carbon (graphite).

10. Pressure of 1 g of an ideal gas A at 27 °C is found to be 2 bar. When 2 g of another ideal gas B is introduced in the same flask at same temperature the pressure becomes 3 bar. What would be the ratio of their molecular masses?
(a) 4 : 1 (b) 1 : 4
(c) 1 : 8 (d) 2 : 8

11. According to Bronsted Lowry concept, the relative strengths of the bases CH_3COO^-, OH^- and Cl^- are in the order
(a) $OH^- > CH_3COO^- > Cl^-$
(b) $Cl^- > OH^- > CH_3COO^-$
(c) $CH_3COO^- > OH^- > Cl^-$
(d) $OH^- > Cl^- > CH_3COO^-$

12. In which of the following does the overlap of two orbitals give a non-bonding interaction?
(a) 
(b) 
(c) 
(d) 

13. $Mg_3B_2 \xrightarrow{HCl_{(aq)}} [X] + MgCl_2$
$[X] + H_2O \rightarrow [Y] + H_2$
Regarding $[X]$ and $[Y]$ the wrong statement is
(a) $[X]$ is BCl_3 and $[Y]$ is H_3BO_3
(b) $[X]$ is B_2H_6 and $[Y]$ is H_3BO_3
(c) $[X]$ with air and $[Y]$ on strong heating (red heat) give same compound
(d) in $[Y]$, B complete its octet by accepting OH^- from water molecule.

14. The reaction shown below goes through classical carbocation. What is the major product of this reaction?

(a) *trans*-1, 3-dibromocyclohexane
(b) *cis*-1, 3-dibromocyclohexane
(c) *trans*-1, 2-dibromocyclohexane
(d) *cis*-1, 2-dibromocyclohexane

15. The solubility product of $Mg(OH)_2$ is 1×10^{-12}. 0.01 M Mg^{2+} will precipitate at the limiting pH of
(a) 9 (b) 3
(c) 8 (d) 5

SOLUTIONS

1. **(a)**

2. **(b) :** $Be_2C + 4H_2O \longrightarrow \underset{X}{2Be(OH)_2} + CH_4$

$Be(OH)_2 + 2HCl_{(aq)} \longrightarrow \underset{(Y)}{BeCl_{2(aq)}} + 2H_2O$

3. **(c) :** $CH_3-\underset{sp^2}{\overset{\overset{O}{\|}}{C}}-NH_2 \xrightarrow{P_2O_5} CH_3-\underset{sp}{C}\equiv N$

4. **(c) :** If the concentration of dissolved oxygen in water is below 6 ppm, the growth of fish gets inhibited.

5. **(a) :** Angular momentum $J = mvr$; $J^2 = m^2v^2r^2$

or $\frac{J^2}{2} = \left(\frac{1}{2}mv^2\right)mr^2$ or $K.E. = \frac{J^2}{2mr^2}$

6. **(d) :** In CN^-, oxidation of C is + 2, and it changes to + 4 oxidation state in CO_2. So C is also oxidised.

7. **(d) :** $C + \frac{1}{2}O_2 \rightarrow CO$ ...(i)

Initial mole $\frac{x}{12}$ $\frac{y}{32}$ 0

Final mole 0 $\quad \frac{y}{32}-\left(\frac{x}{12}\right)\frac{1}{2}$

$$CO + \frac{1}{2}O_2 \rightarrow CO_2 \qquad ...(ii)$$

For no solid residue CO should be zero in eq. (i)

For that $\frac{y}{32}-\frac{x}{12}\times\frac{1}{2}\geq 0$

$$\frac{y}{32}\geq\frac{x}{24}\ ;\ \frac{y}{x}\geq\frac{32}{24}\ ;\ \frac{y}{x}\geq 1.33$$

8. **(b):** Elements X, Y and Z with atomic numbers 19, 37, 55 lie in group 1 (alkali metals). Within a group, ionisation potential decreases from top to bottom. Ionisation potential of $_{37}Rb$ is higher than $_{55}Cs$ and lower than $_{19}K$.

9. **(d)**

10. **(b):** For gas A, $P_AV=\frac{m_A}{M_A}RT$ ...(i)

For gas B, $P_BV=\frac{m_B}{M_B}RT$ ...(ii)

Dividing equation (i) by equation (ii) gives

$$\frac{P_A}{P_B}=\frac{m_A}{m_B}\frac{M_B}{M_A}$$

$P_A + P_B = 3 \Rightarrow P_B = 3 - 2 = 1$ bar

$$\frac{M_A}{M_B}=\left(\frac{m_A}{m_B}\right)\left(\frac{P_B}{P_A}\right)=\left(\frac{1\,g}{2\,g}\right)\left(\frac{1\,bar}{2\,bar}\right) \Rightarrow \frac{M_A}{M_B}=1:4$$

11. **(a):** Acidic strength order : $HCl > CH_3COOH > H_2O$

Conjugate base strength order :

$Cl^- < CH_3COO^- < OH^-$

12. **(d):** Partial positive-positive and partial positive-negative overlap leads to non bonding interaction.

13. **(a):** $Mg_3B_2 \xrightarrow{HCl_{(aq)}} \underset{[X]}{MgCl_2} + B_2H_6$

$[X]$ is not BCl_3, it is B_2H_6.

$$B_2H_6 + 6H_2O \longrightarrow \underset{[Y]}{2H_3BO_3} + 6H_2$$

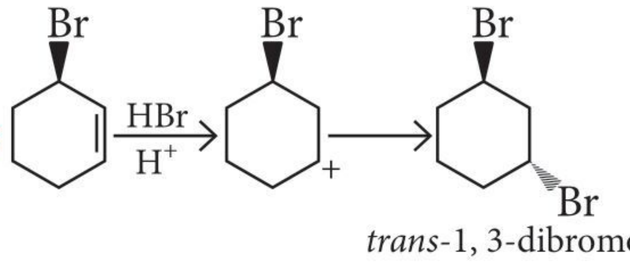
Both $[X]$ and $[Y]$ gives B_2O_3.

$$B_2H_6 + 3O_2 \longrightarrow B_2O_3$$

$$H_3BO_3 \xrightarrow[Heat]{Red} B_2O_3$$

$$B(OH)_{3(aq)} + 2H_2O \longrightarrow B(OH)^-_4 + H_3O^+_{(aq)}$$

14. **(a):**



trans-1, 3-dibromocyclohexane

15. **(a):** K_{sp} for $Mg(OH)_2 = [Mg^{2+}][OH^-]^2$

$\therefore \quad 10^{-12} = (0.01)[OH^-]^2$

$[OH^-] = 10^{-5}$ M

$\Rightarrow \quad [H^+] = 10^{-9}$ M or pH = 9

◈ ◈

For the SCIENTIST in YOU

Wastewater treatment system recovers electricity, filters water

The waste materials in wastewater are full of organic materials which, to bacteria, are food.

The system is set up like a typical microbial fuel cell, a bacterial battery that uses electrochemically active bacteria as a catalyst where a traditional fuel cell would use platinum. In this type of system, the bacteria are attached to the electrode. When wastewater is pumped into the anode, the bacteria "eat" the organic materials and release electrons, creating electricity.

To filter that same water, however, requires a different system i.e., developing a permeable anode that acts as a filter.

The anode is a dynamic membrane, made of conductive, carbon cloth. Together, the bacteria and membrane filter out 80% to 90% of organic materials -- that leaves water clean enough to be released into nature or further treated for non-potable water uses.

Researchers used a mixed culture of bacteria, but they had to share one feature -- the bacteria had to be able to survive in a zero-oxygen environment.

"If there was oxygen, bacteria would just dump electrons to the oxygen not the electrode," They said. "If you cannot respire with the electrode, you'll perish."

"It's not 100 percent natural, but we select those that can survive in this condition," Researchers said. "It's more like 'engineered selection,'" the bacteria that did survive and respire with the electrode were selected for the system.

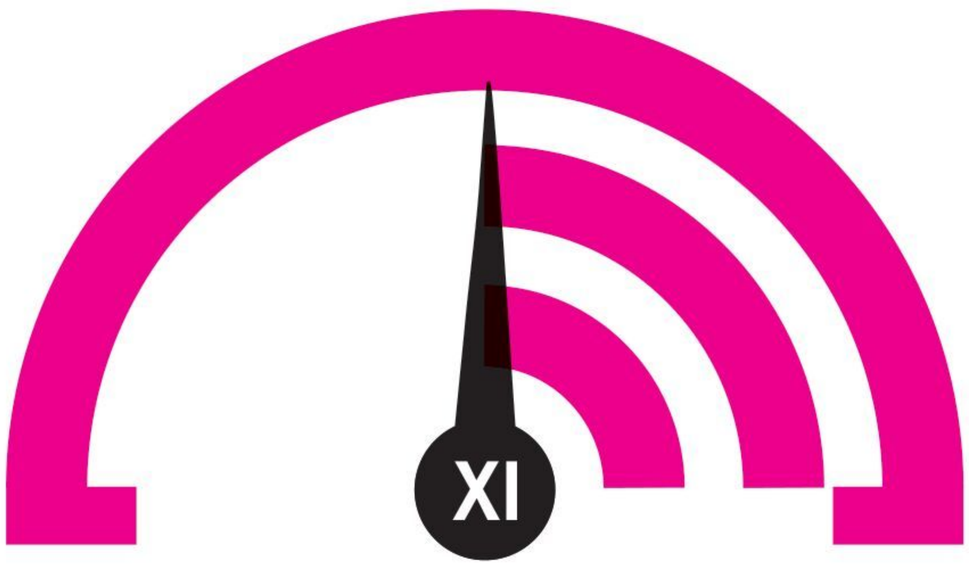
The amount of electricity created is not enough to, say, power a city, but it is in theory enough to help to offset the substantial amount of energy used in a typical water treatment plant.

"Typically, the process consumes about 0.5 KWH of electricity per cubic meter," Researchers said. Based on bench scale experiments, "We can reduce it by half, or more of that."

But the primary goal of this system isn't electricity production, it's wastewater treatment and nutrient recovery.

"Bacteria can convert those organic materials into things we can use," Researchers said. "We can also recover nutrients like nitrogen or phosphorus for fertilizer. We can use it to feed plants. It's only when we don't use it, then it becomes waste.

MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120

PRACTICE PAPER

Time Taken : 60 Min.

NEET

Only One Option Correct Type

1. The volume strength of 1.5 N H_2O_2 solution is
(a) 4.8 (b) 8.4 (c) 3.0 (d) 8.0

2. When water is dropped over sodium peroxide, the colourless gas produced is
(a) dinitrogen (b) dioxygen
(c) dihydrogen (d) hydrogen peroxide.

3. The ozone in the stratosphere is destroyed by
(a) $^{\bullet}Cl$ (b) $^{\bullet}OH$ (c) $^{\bullet}H$ (d) $^{\bullet}ClO$

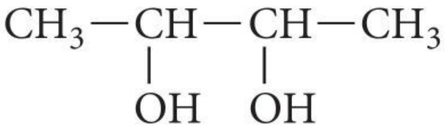
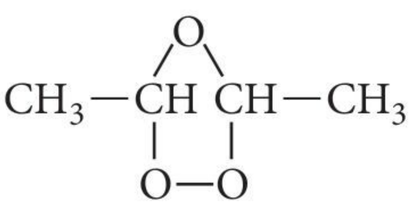
4. A mineral containing iron (II) sulphide but no other sulphide is treated with excess of hydrochloric acid to produce hydrogen sulphide gas. If 3.15 g sample of mineral yielded 448 mL of hydrogen sulphide gas at 0 °C and 760 mm pressure, the mass percentage of iron (II) sulphide in the sample is
(a) 20.6 (b) 35.2 (c) 55.8 (d) 72.4

5. Wavelength of high energy transition of H-atom is 91.2 nm. The corresponding wavelength of He^+ is
(a) 91.2 nm (b) 22.8 nm
(c) 54.5 nm (d) 45.6 nm

6. Considering that NaOH neither oxidises nor reduces CrO_2Cl_2, which of the following species will be formed when CrO_2Cl_2 is dissolved in NaOH solution?
(a) CrO_4^{2-} (b) Cl_2O
(c) ClO_2 (d) $Cr(OH)_3$

7. The equilibrium constant value for the equilibrium :
$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$
changes with
(a) total pressure (b) temperature
(c) catalyst
(d) amount of H_2 and I_2 present.

8. Which of the following sets of quantum numbers is correct for a 4*d*-electron?
(a) $4, 3, 2, +\frac{1}{2}$ (b) 4, 2, 1, 0
(c) $4, 2, -2, +\frac{1}{2}$ (d) $4, 2, 3, -\frac{1}{2}$

9. Product '*P*' of the given reaction,
$CH_3-CH=CH-CH_3 \xrightarrow[-78\ ^\circ C]{O_3/CH_2Cl_2} P$, will be
(a) CH_3-CHO (b) CH_3-COOH
(c) 
(d) 

10. Which of the following is not true?
(a) SH_6 and $BiCl_5$ do not exist.
(b) There are two $p\pi$–$d\pi$ bonds in SO_3^{2-}.
(c) SeF_4 and CH_4 are tetrahedral species.
(d) I_3^- is a linear molecule with sp^3d-hybridisation.

11. What is the general electronic configuration for 2nd row transition series?
(a) $[Ne]3d^{1-10}, 4s^2$ (b) $[Ar]3d^{1-10}, 4s^{1-2}$
(c) $[Kr]4d^{1-10}, 5s^{1-2}$ (d) $[Xe]5d^{1-10}, 5s^{1-2}$

12. $2Al_{(s)} + Fe_2O_{3(s)} \rightarrow Al_2O_{3(s)} + 2Fe_{(s)}; \Delta H^\circ = -851.4 kJ mol^{-1}$.
How much heat is released when 72.0 g of Al reacts with excess Fe_2O_3?

(a) 1135 kJ mol^{-1} (b) 1278 kJ mol^{-1}
(c) 2.28×10^3 kJ mol^{-1} (d) 2.54×10^3 kJ mol^{-1}

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** F atom has a less negative electron affinity than Cl atom.
Reason : Additional electrons are repelled more effectively by 3*p* electrons in Cl atom than by 2*p* electrons in F atom.

14. **Assertion :** Sodium reacts with oxygen to form Na_2O_2 whereas potassium reacts with oxygen to form KO_2.
Reason : Potassium is more reactive than sodium.

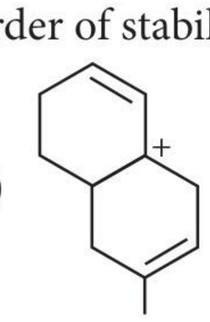
15. **Assertion :** An endothermic reaction gives a better yield of products at higher temperature.
Reason : The equilibrium constant of an endothermic reaction increases with increasing temperature.

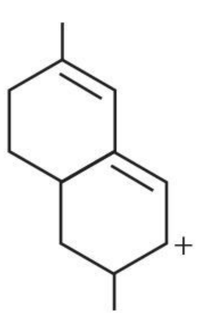
JEE MAIN / JEE ADVANCED

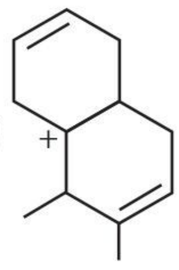
Only One Option Correct Type

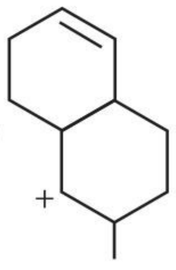
16. Na_2SiO_3 is a polymer. How many O-atoms are shared by each SiO_4^{4-} tetrahedron with other SiO_4^{4-} tetrahedra?
(a) 0 (b) 1 (c) 2 (d) 3

17. Rank the following carbocations in increasing order of stability :

(i) 

(ii) 

(iii) 

(iv) 

(a) iv < iii < i < ii (b) iv < i < iii < ii
(c) iii < ii < i < iv (d) i < iii < ii < iv

18. The pK_a of acetyl salicylic acid (aspirin) is 3.5. The pH of gastric juice in the human stomach is about 2 to 3 and the pH in the small intestine is 8. Aspirin will be
(a) unionised in the small intestine and in the stomach
(b) completely ionised in the small intestine and in the stomach
(c) ionised in the stomach and almost unionised in the small intestine
(d) ionised in the small intestine and almost unionised in the stomach.

19. Which of the following are isoelectronic and isostructural?
NO_3^-, CO_3^{2-}, ClO_3^-, SO_3
(a) CO_3^{2-}, ClO_3^- (b) CO_3^{2-}, NO_3^-
(c) SO_3, ClO_3^- (d) SO_3, NO_3^-

More than One Options Correct Type

20. Which of the following statements are false?
(a) $BeCl_2$ exists as dimer in the vapour state and polymeric in the solid state.
(b) Calcium hydride is called hydrolith.
(c) The oxides of Be and Ca are amphoteric.
(d) Bicarbonates of Na and Sr are insoluble in water.

21. Which of the following reactions involve increase in entropy?
(a) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$
(b) $2HI_{(g)} \rightarrow H_{2(g)} + I_{2(g)}$
(c) $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(l)}$
(d) S (Rhombic) + $O_{2(g)} \rightarrow SO_{2(g)}$

22. Which of the following reactions are correctly represented?
(a) $R-CH=CH_2 + HCl \rightarrow R-\underset{\underset{Cl}{|}}{CH}-CH_3$
(b) $R-CH=CH_2 + HI \xrightarrow{\text{Peroxide}} R-CH_2-CH_2-I$
(c) $R-CH=CH_2 + HBr \xrightarrow{\text{Peroxide}} R-CH_2-CH_2-Br$
(d) $R-CH=CH_2 + HI \xrightarrow{\text{Peroxide}} R-\underset{\underset{I}{|}}{CH}-CH_3$

23. The $\Delta_i H$ and $\Delta_{eg} H$ of an element *A* are + 450 kJ mol^{-1} and −100 kJ mol^{-1}. Which of the following options are true with respect to A^+ and A^- ions ?
(a) $\Delta_{eg} H$ of $A^+ = -450$ kJ mol^{-1}
(b) $\Delta_i H$ of $A^- = -100$ kJ mol^{-1}
(c) $\Delta_{eg} H$ of $A^+ = +350$ kJ mol^{-1}
(d) $\Delta_i H$ of $A^- = +550$ kJ mol^{-1}

Integer / Numerical Value Type

24. The number of stereoisomers obtained by bromination of *trans*-2-butene is

25. An alkaloid contains 17.28% of nitrogen and its molecular mass is 162. The number of nitrogen atoms present in one molecule of the alkaloid is

26. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is 1 Å, $1/x$ of an electronic charge exists on each atom. The value of x is

Comprehension Type

The percentage labelling of oleum (mixture of H_2SO_4 and SO_3) refers to the total mass of pure H_2SO_4. The total amount of H_2SO_4 found after adding calculated amount of water to 100 g oleum is the percentage labelling of oleum. Higher the percentage labelling of oleum, higher is the amount of free SO_3 in the oleum sample.

27. What is the amount of free SO_3 in an oleum sample labelled as '118%'?

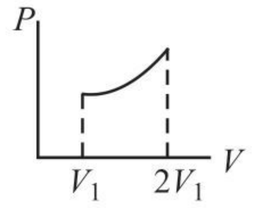
(a) 40% (b) 50% (c) 70% (d) 80%

28. 100 g sample of '147%' oleum was taken and calculated amount of H_2O was added to make H_2SO_4 solution. 500 mL of x M KOH solution is required to neutralise the H_2SO_4 solution. The value of x is

(a) 1 (b) 2 (c) 4 (d) 6

Matrix Match Type

29. Match List I containing a list of processes involving expansion of an ideal gas with List II describing the thermodynamic change during corresponding process and choose the correct answer using the codes given below the lists.

List I	List II
P. An insulated container has two chambers separated by a valve. Chamber I contains an ideal gas and the chamber II has vacuum. The valve is opened.	(i) The temperature of the gas decreases.
Q. An ideal monoatomic gas expands to twice its original volume such that its pressure $P \propto \frac{1}{V^2}$; where, V is the volume of the gas.	(ii) The temperature of the gas remains constant.
R. An ideal monoatomic gas expands to twice its original volume such that its pressure $P \propto \frac{1}{V^{4/3}}$; where, V is its volume.	(iii) The temperature of the gas increases.
S. An ideal monoatomic gas expands such that its pressure P and volume V follows the behaviour shown in the graph: 	(iv) The gas loses heat.
	(v) The gas gains heat.

	P	Q	R	S
(a)	(i, iii)	(ii)	(iv)	(i, ii)
(b)	(ii)	(i, iv)	(i, iii)	(ii, iv)
(c)	(ii)	(i, v)	(i, v)	(iii, v)
(d)	(iii, iv)	(i, ii)	(iv)	(i)

30. Match the Column I with Column II and mark the appropriate option.

Column I	Column II
(A) $1s$	(P) $m_l = 0$
(B) $2p_z$	(Q) Nodal planes = 2
(C) $3d_{xy}$	(R) Radial nodes = 0
(D) $3d_{z^2}$	(S) Number of maxima = 1

	A	B	C	D
(a)	P, R, S	P, R, S	Q, R, S	P, R, S
(b)	Q, S	P, R, S	Q, R	P, S
(c)	P, R, S	Q	P	P, Q
(d)	R, S	P, Q	Q, S	Q, R, S

Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

LEARN FAST

SOME IMPORTANT PROPERTIES AND COMPOUNDS OF p-BLOCK ELEMENTS

Group 15

Chemical Properties of Group 15 Elements

Chemical properties

Oxides

Group 15 elements form oxides of type X_2O_3, X_2O_4, X_2O_5

Acidic nature decreases (left to right), increases (down the group)

Hydrides

Thermal stability : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Solubility : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Basic character : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Bond angle : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Reducing character : $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

Covalent character : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Oxidation state

Stability of +3 increases and +5 decreases down the group.

Halides (MX_3 and MX_5)

Group 15 elements form MX_3, whereas all form MX_5 except nitrogen.

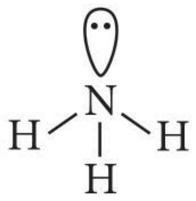
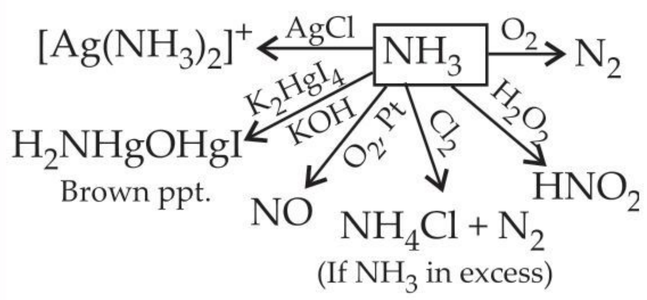
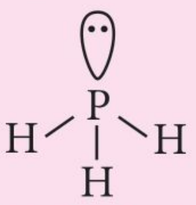
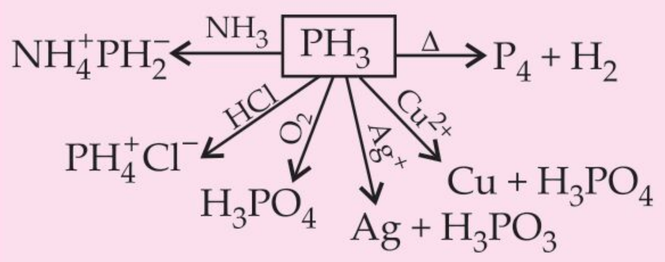
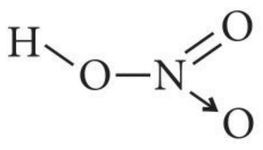
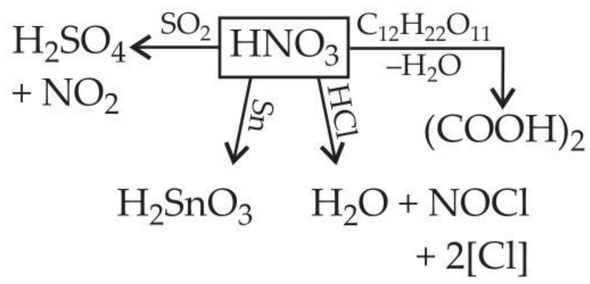
Stability : $NF_3 > NCl_3 > NBr_3$

Lewis acid strength : $PCl_3 > AsCl_3 > SbCl_3$ and $PF_3 > PBr_3 > PI_3$

Lewis base strength : $NI_3 > NBr_3 > NCl_3 > NF_3$

Bond angle : $PF_3 < PCl_3 < PBr_3 < PI_3$ (increasing *b.p.* – *b.p.* repulsions)

Important Compounds of Nitrogen and Phosphorus

Compounds	Preparations	Properties
Ammonia (NH_3)  sp^3 hybridisation (pyramidal)	**Haber's process :** $N_{2(g)} + 3H_{2(g)} \rightleftharpoons^{773K} 2NH_{3(g)}$ $NH_4Cl + NaOH \longrightarrow NH_3 + H_2O + NaCl$ $2NH_4Cl + Ca(OH)_2 \xrightarrow{\Delta} CaCl_2 + 2NH_3 + 2H_2O$ Slaked lime $Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$	
Phosphine (PH_3)  sp^3 hybridisation (pyramidal)	$4H_3PO_3 \xrightarrow{478\text{-}483\ K} 3H_3PO_4 + PH_3$ $P_4 + 3NaOH + 3H_2O \longrightarrow 3NaH_2PO_2 + PH_3$ $PH_4I + KOH \longrightarrow PH_3 + KI + H_2O$ $Ca_3P_2 + 6H_2O \longrightarrow 3Ca(OH)_2 + 2PH_3$	
Nitric acid (HNO_3) 	$2KNO_3 + H_2SO_4 \longrightarrow 2HNO_3 + K_2SO_4$ $4NH_{3(g)} + 5O_{2(g)} \xrightarrow[500\ K,\ 9\ bar]{Pt/Rh\ gauge} 4NO_{(g)} + 6H_2O_{(g)}$ $2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$ $3NO_{2(g)} + H_2O_{(l)} \longrightarrow 2HNO_{3(aq)} + NO_{(g)}$	

Group 16

Chemical Properties of Group 16 Elements

Chemical properties

Oxidation state

Stability of –2, +6 oxidation states decreases down the group and +4 oxidation state increases down the group.

Hydrides

Boiling point : $H_2O > H_2Te > H_2Se > H_2S$

Volatility : $H_2S > H_2Se > H_2Te > H_2O$

Bond angle : $H_2O > H_2S > H_2Se > H_2Te$

Acidic character : $H_2O < H_2S < H_2Se < H_2Te$

Reducing power : $H_2Te > H_2Se > H_2S > H_2O$

Halides (EX_6, EX_4 and EX_2)

Hexahalides stability: $SF_6 > SeF_6 > TeF_6$

Tetrahalides : SF_4(gas), SeF_4 (liquid), TeF_4 (solid). SF_4 readily hydrolysed than SF_6.

Dihalides : All elements except selenium form dihalides.

Monohalides : Dimeric in nature and undergoes disproportionation.

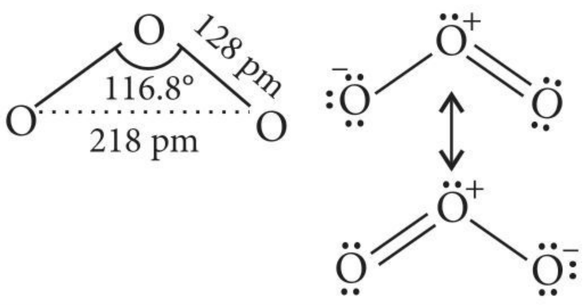
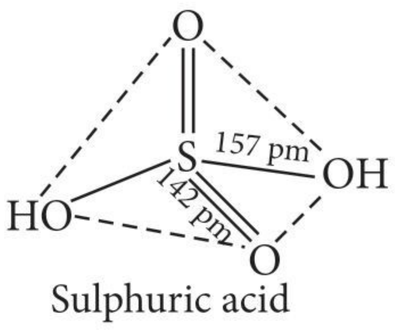
Oxides

Monoxides : Except selenium, all elements form monoxides, MO.

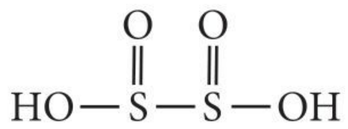
Dioxides : All elements form dioxides MO_2, when burnt in air. SO_2 (monomeric), SeO_2 (polymeric), TeO_2 and PoO_2 (ionic solids).

Trioxides : Sulphur, selenium, tellurium form trioxides, MO_3.

Important Compounds of Oxygen and Sulphur

Compounds	Preparation	Properties
Ozone (O_3) 	$3O_2 \underset{\text{Silent electric discharge}}{\rightleftharpoons} 2O_3$	$O_3 \xrightarrow{NO} O_2 + NO_2$ $O_3 \xrightarrow{H_2S} H_2O + S + O_2$ $O_3 \xrightarrow{KOH} KO_3$ $O_3 \xrightarrow{PbS} PbSO_4$ $O_3 \xrightarrow{HCl + SnCl_2} SnCl_4$ $O_3 \xrightarrow[H_2O/Zn]{CH_2=CH_2} HCHO$
Sulphuric acid (H_2SO_4)  Sulphuric acid	**Contact process :** $2SO_{2(g)} + O_{2(g)} \xrightarrow{V_2O_5} 2SO_{3(g)}$ $SO_3 \xrightarrow{H_2SO_4} H_2S_2O_7$ $H_2S_2O_7 \xrightarrow{H_2O} 2H_2SO_4$	$H_2SO_4 \xrightarrow{NaOH} NaHSO_4 + H_2O$ $H_2SO_4 \xrightarrow{2NaOH} Na_2SO_4 + 2H_2O$ $H_2SO_4 \xrightarrow{Zn} ZnSO_4 + H_2$ $H_2SO_4 \xrightarrow{C_{12}H_{22}O_{11}} 12C + 11H_2O$ $H_2SO_4 \xrightarrow{S_8} SO_2 + H_2O$ $H_2SO_4 \xrightarrow{Na_2S} Na_2SO_4 + H_2S$ $H_2SO_4 \xrightarrow{BaCl_2} BaSO_4 + HCl$ $H_2SO_4 \xrightarrow{K_4[Fe(CN)_6]} K_2SO_4 + FeSO_4 + (NH_4)_2SO_4 + CO\uparrow$

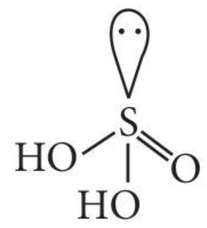
Hyposulphurous acid ($H_2S_2O_4$)



Unstable in pure form but stable as salts.
O.S. of S = +3

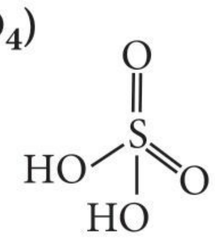
Sulphurous acid (H_2SO_3)

Dibasic acid, strong reducing agent.
O.S. of S = +4

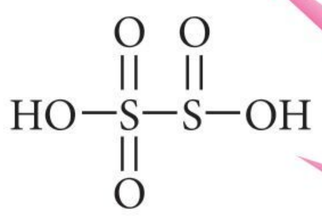


Sulphuric acid (H_2SO_4)

Dibasic acid, strong oxidising and dehydrating agent.
O.S. of S = +6

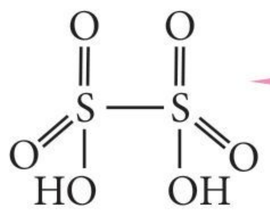


Pyrosulphurous acid or Disulphurous acid ($H_2S_2O_5$)



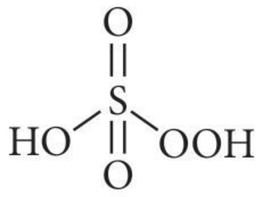
O.S. of S = +3 and +5

Dithionic acid ($H_2S_2O_6$) :



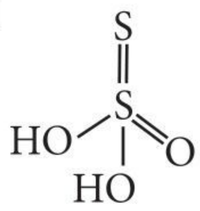
Dibasic acid
O.S. of S = +5

Peroxomonosulphuric acid (Caro's acid) (H_2SO_5)



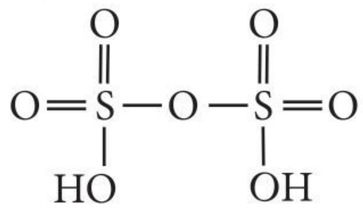
Monobasic acid, strong oxidising agent.
O.S. of S = +6

Thiosulphuric acid ($H_2S_2O_3$)



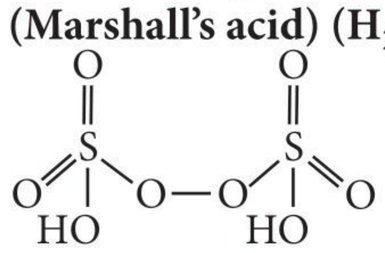
Dibasic acid, reducing agent.
O.S. of S = –2, +6

Disulphuric acid or Pyrosulphuric acid ($H_2S_2O_7$)



A sulphuric acid analogue of acetic anhydride.
O.S. of S = +6

Peroxodisulphuric acid (Marshall's acid) ($H_2S_2O_8$)



Dibasic acid, strong oxidising agent.
O.S. of S = +6

Oxoacids of sulphur

Group 17

Chemical Properties of Group 17 Elements

Chemical properties

Oxidation state

F shows only – 1 oxidation state (except +1 in HOF while other elements show –1, +1, +3, +5 and +7 oxidation states also.

Hydrogen halides

Boiling points : HF > HI > HBr > HCl
Melting points : HI > HF > HBr > HCl
Bond lengths : HI > HBr > HCl > HF
Bond dissociation enthalpy : HF > HCl > HBr > HI
Acidic strength : HI > HBr > HCl > HF
Thermal stability : HF > HCl > HBr > HI
Reducing power : HI > HBr > HCl > HF

Oxides

OF_2, O_2F_2
Cl_2O, ClO_2, Cl_2O_6 and Cl_2O_7
Br_2O, BrO_2, BrO_3
I_2O_4, I_4O_9
All are covalent and powerful oxidising agents.
Oxidising power : $Cl_2O > ClO_2 > Cl_2O_6 > Cl_2O_7$
Stability : $Cl_2O < ClO_2 < Cl_2O_6 < Cl_2O_7$

Oxoacids

Acid strength : $HClO_4 > HClO_3 > HClO_2 > HClO$; HOCl > HOBr > HOI
Oxidising power : HOCl ≃ HOBr > HOI; $BrO_4^- > IO_4^- > ClO_4^-$
$HClO_4 < HClO_3 < HClO_2 < HClO$

Important Compounds of Halogen Family

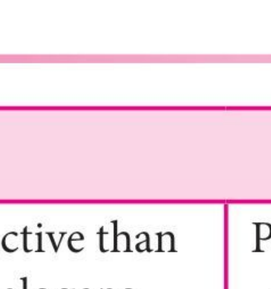
Compounds	Preparation	Properties
Chlorine (Cl_2)	**Laboratory method :** $2NaCl + 3H_2SO_4 + MnO_2 \longrightarrow 2NaHSO_4 + MnSO_4 + 2H_2O + Cl_2$	$Cl_2 + 2FeSO_4 + H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + HCl$ $Cl_2 + H_2S \longrightarrow 2HCl + S$ $Cl_2 + 2NaOH_{(dil.)} \longrightarrow NaCl + NaOCl + H_2O$ $3Cl_2 + 6NaOH_{(conc.)} \longrightarrow 5NaCl + NaClO_3 + 3H_2O$ $Cl_2 \xrightarrow{H_2O} 2HCl + [O] \xrightarrow[\text{substance}]{\text{Coloured}} \text{Colourless}$
Hydrogen Chloride (HCl)	$NaCl + H_2SO_4 \xrightarrow{420\ K} NaHSO_4 + HCl$ $NaHSO_4 + NaCl \xrightarrow{823\ K} Na_2SO_4 + HCl$	Colourless and pungent smelling gas, easily liquifiable, extremely soluble in water. $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$ $Na_2SO_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2$

Oxoacids of halogens :

Oxidation state of halogen	Chlorine	Bromine	Iodine	Name of acid
+1	$HClO$	$HBrO$	HIO	Hypohalous
+3	$HClO_2$	–	–	Halous
+5	$HClO_3$	$HBrO_3$	HIO_3	Halic
+7	$HClO_4$	$HBrO_4$	HIO_4 H_5IO_6	Perhalic

Interhalogen Compounds

Properties					
Covalent in nature	Strong oxidising agents	Diamagnetic in nature	Reactive than halogens	Partially ionised in solution or in liquid state	Coloured in nature

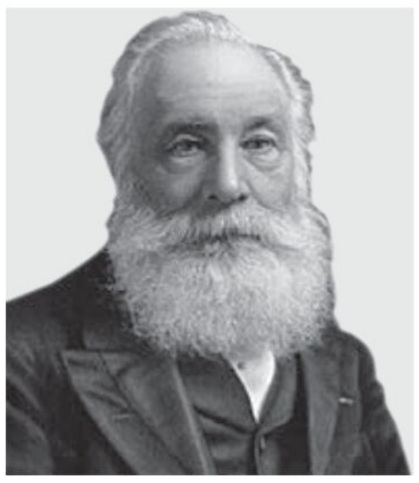
Types of interhalogen compounds			
AX_5 sp^3d^2 Square pyramidal 	AX sp^3 Linear 	AX_7 sp^3d^3 Pentagonal bipyramidal 	AX_3 sp^3d T-shaped 

Compounds of Xenon

Compound	Preparation	Properties
Xenon difluoride (XeF_2)	$Xe + F_2 \xrightarrow[\text{(Xe in excess)}]{673\ K,\ 1\ bar} XeF_2$	Linear, sp^3d
Xenon tetrafluoride (XeF_4)	$Xe + 2F_2 \xrightarrow[\text{(1 : 5)}]{\substack{873\ K \\ 6\text{-}7\ bar}} XeF_4$	Square planar, dsp^2
Xenon hexafluoride (XeF_6)	$Xe + 3F_2 \xrightarrow[\text{(1 : 20)}]{\substack{573\ K \\ 60\text{-}70\ bar}} XeF_6$	Distorted octahedral, sp^3d^3
Xenon trioxide (XeO_3)	$XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$	Pyramidal, sp^3
Xenon oxydifluoride ($XeOF_2$)	$XeF_4 + H_2O \longrightarrow XeOF_2 + 2HF$	T-shaped, sp^3d
Xenon oxytetrafluoride ($XeOF_4$)	$XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$	Square pyramidal, sp^3d^2
Xenon dioxydifluoride (XeO_2F_2)	$XeOF_4 + H_2O \longrightarrow XeO_2F_2 + 2HF$	Distorted trigonal bipyramidal, sp^3d

Scientist of the Month

Sir William Henry Perkin



Sir William Henry Perkin
(12 March 1838 – 14 July 1907)

Early Life and Education

William Perkin was born on 12 March 1838 in East End of London. At the age of 14, Perkin attended the City of London School, where he was taught by Thomas Hall, who fostered his scientific talent and encouraged him to pursue a career in chemistry.

In 1853, at the age of 15, Perkin entered the Royal College of Chemistry in London, where he began his studies under August Wilhelm von Hofmann.

Contributions

- In 1856, he discovered that aniline could be partly transformed into a crude mixture which, when extracted with alcohol, produced a substance with an intense purple colour, he commercialised it as a dye mauveine. At that time, all dyes used for colouring cloth were natural substances, many of which were expensive and labour-intensive to extract. Perkin filed for a patent in August 1856, when he was still only 18.
- After the discovery of mauveine, many new aniline dyes appeared (some discovered by Perkin himself), and factories producing them were constructed across Europe. He introduced aniline red in 1859, aniline black in 1863 and alkalate magenta in 1864.
- In 1869, Perkin found a method for the commercial production of the brilliant red dye alizarin from anthracene.
- Perkin's further experimentation led to his discovery of a method for changing the structure of organic compounds at the molecular level. Using this process, known as, "Perkin Synthesis," he produced coumarin, a synthetic perfume which has been described as smelling like fresh hay or vanilla.
- Later, he researched on the development of a process for producing glycine and tartaric acid, as well as significant research on the similarities between tartaric acid and maleic acids.
- He is considered to be the father of synthetic dye and perfume industries.

Awards and Honours

- Royal Medal (1879)
- Davy Medal (1889)
- Albert Medal (1890)
- Perkin Medal (1906)

GET SET GO for JEE

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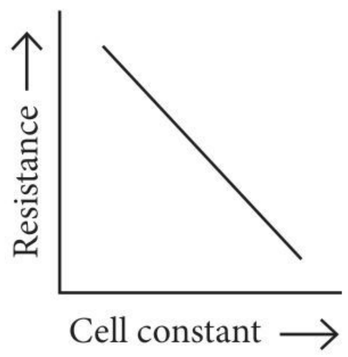
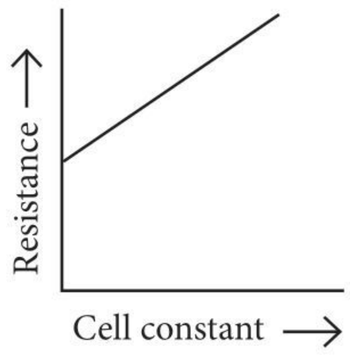
Practicing these MCQs help to strengthen your concepts and give you extra edge in your JEE preparation

1. Variation of resistance with increase in cell constant gives graph of the type

(a)


(b)


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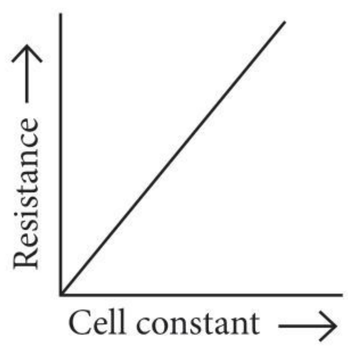
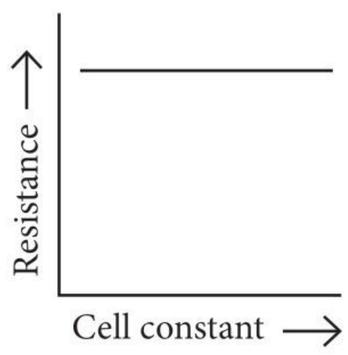


(d)


2. Toluene by Etard's reaction gives

(a) *ortho*-cresol (b) benzoic acid
(c) benzyl alcohol (d) benzaldehyde.

3. Identify (*X*), (*Y*) and (*Z*) in the given reaction.

$$CH_3COCH_3 \xrightarrow[\text{heat}]{I_2 + NaOH} X \xrightarrow[\text{heat}]{Ag} Y \xrightarrow[\text{heat}]{H_2SO_4/HgSO_4} Z$$

(a) $X = CHI_3$, $Y = CH_3CHO$, $Z = HCHO$
(b) $X = CHI_3$, $Y = CH_3OH$, $Z = CH_3CHO$
(c) $X = CHI_3$, $Y = CH \equiv CH$, $Z = CH_3CHO$
(d) $X = CH_3COCI_3$, $Y = CH_2 = CH_2$, $Z = CH_3CHO$

4. Monomer of $\left[-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - CH_2 - \right]_n$ is

(a) 2-methylpropene (b) styrene
(c) propylene (d) ethene.

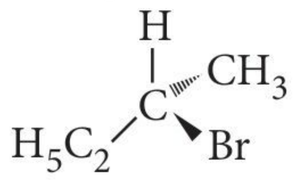
5. The rate constant, the activation energy and the Arrhenius parameter of a chemical reaction at 25°C are $3.0 \times 10^{-4}\ s^{-1}$, 104.4 kJ mol^{-1} and $6.0 \times 10^{14}\ s^{-1}$ respectively. The value of the rate constant at $T = \infty$ is

(a) $2.0 \times 10^{18}\ s^{-1}$ (b) $6.0 \times 10^{14}\ s^{-1}$
(c) infinity (d) $3.6 \times 10^{30}\ s^{-1}$.

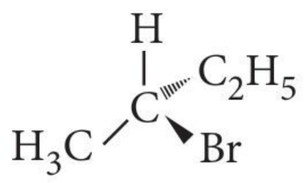
6. The main reason for larger number of oxidation states exhibited by the actinides than those of corresponding lanthanides, is

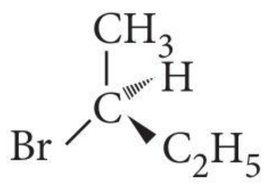
(a) lesser energy difference between 5*f* and 6*d* orbitals than between 4*f* and 5*d*-orbitals
(b) larger atomic size of actinides than the lanthanides
(c) more energy difference between 5*f* and 6*d* orbitals than between 4*f* and 5*d*-orbitals
(d) greater reactive nature of the actinides than the lanthanides.

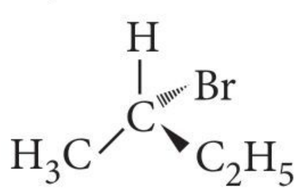
7. Which of the following structures is enantiomeric with the molecule (*A*) given below?

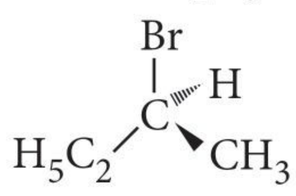


(*A*)

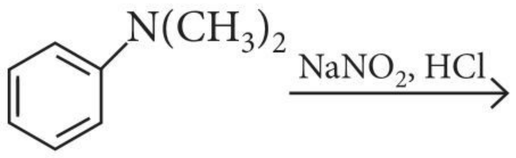
(a) 

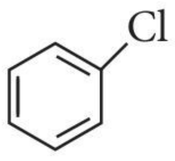
(b) 

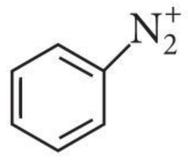
(c) 

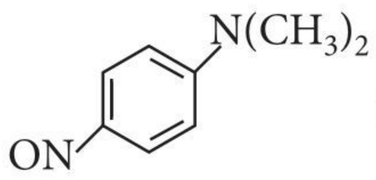
(d) 

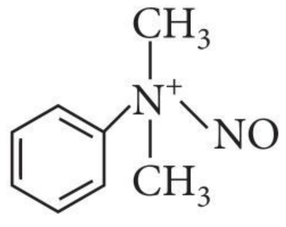
8. What could be the product for the following reaction?



(a) 

(b) 

(c) 

(d) 

9. The composition of a sample of wustite is $Fe_{0.93}O$. What is the percentage of iron present as Fe^{3+} ?

(a) 15% (b) 25%

(c) 35% (d) 45%

10. What is the colour of the end product '*Y*' of the following set of reactions?

Phenol + Phthalic anhydride $\xrightarrow[\Delta]{\text{conc. } H_2SO_4} X \xrightarrow{NaOH} Y$

(a) Green (b) Blue

(c) Pink (d) Yellow

11. The total number of possible isomers of the complex compound $[Cu^{II}(NH_3)_4][Pt^{II}Cl_4]$ is

(a) 3 (b) 6

(c) 5 (d) 4

12. Plot of $\frac{1}{X_A}$ *vs* $\frac{1}{Y_A}$ (X_A mole fraction of *A* in liquid and Y_A in vapour) is linear whose slope and intercept respectively are

(a) $p_B^\circ/p_A^\circ, \frac{p_B^\circ - p_A^\circ}{p_B^\circ}$ (b) $p_A^\circ - p_B^\circ, \frac{p_A^\circ - p_B^\circ}{p_B^\circ}$

(c) $p_A^\circ/p_B^\circ, \frac{p_B^\circ - p_A^\circ}{p_B^\circ}$ (d) $p_B^\circ - p_A^\circ, \frac{p_A^\circ - p_B^\circ}{p_B^\circ}$

13. If an oil soluble dye is mixed with water-in-oil emulsion then,

(a) dispersion medium will be coloured

(b) dispersed phase will be coloured

(c) both (a) and (b)

(d) none of these

14. On reaction with Cl_2, phosphorus forms two types of halides '*A*' and '*B*'. Halide '*A*' is yellowish white powder but halide '*B*' is colourless oily liquid. Which of the following are their hydrolysis products respectively?

(I) H_3PO_2 (III) H_3PO_3

(II) H_3PO_4 (IV) H_3PO_5

(a) I and II (b) II and III

(c) III and IV (d) I and IV

15. A 100 mL solution of 0.1 N HCl was titrated with 0.2 N NaOH solution. The titration was discontinued after adding 30 mL of NaOH solution. The remaining titration was completed by adding 0.25 N KOH solution. The volume of KOH required for completing the titration is

(a) 70 mL (b) 32 mL

(c) 35 mL (d) 16 mL.

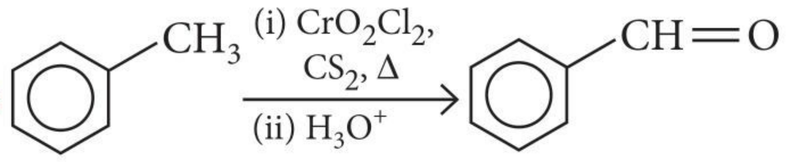
SOLUTIONS

1. **(c) :** We know that the electrical resistance of electrolytic solutions is directly proportional to its length (l) and inversely proportional to its area of cross-section (a) *i.e.*,

$$R \propto \frac{l}{a} \Rightarrow R = \rho\frac{l}{a}$$

Comparing with $y = mx + c$.

The graph of R *vs* (l/a) will be a straight line starting from the origin with slope ρ.

2. **(d) :** 

3. **(c) :** $CH_3COCH_3 \xrightarrow[\text{Heat}]{I_2 + NaOH} \underset{(X)}{CHI_3} \xrightarrow[\text{Heat}]{Ag} \underset{(Y)}{CH{\equiv}CH}$

$\downarrow H_2SO_4/HgSO_4$

$\underset{(Z)}{CH_3CHO}$

4. **(a)**

5. **(b) :** According to Arrhenius equation, $k = Ae^{-E_a/RT}$

At $T = \infty$, $k = A = 6.0 \times 10^{14}\ s^{-1}$.

6. **(a)**

7. **(a) :** Structure (a) is enantiomer of molecule (*A*) because in this, the configuration of two groups, *i.e.*, CH_3 and C_2H_5 is reversed at the chiral carbon.

8. **(c)**

9. **(a) :** Let, no. of O^{2-} ions in $Fe_{0.93}O$ = 100

$\therefore$ Total no. of Fe^{2+} and Fe^{3+} ions = 93

Let no. of Fe^{2+} ions in the sample = x and

no. of Fe^{3+} ions in the sample = y

$\therefore$ $x + y = 93$ ...(i)

Total –ve charge carried by 100 O^{2-} ions = 200

Total +ve charge carried by x Fe^{2+} ions = $2x$

Total +ve charge by y Fe^{3+} ions = $3y$

Thus, $2x + 3y = 200$ ...(ii)

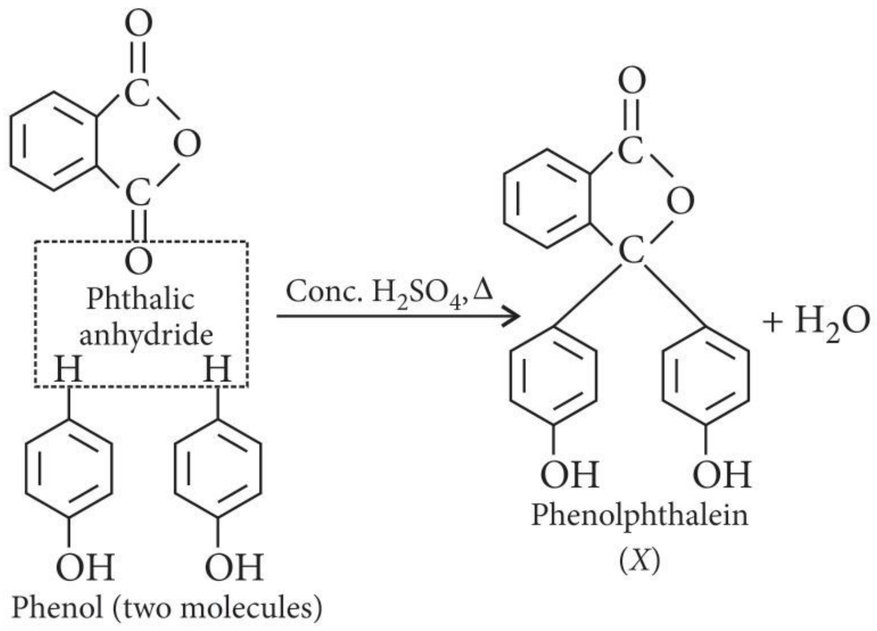
Solving (i) and (ii), we get $x = 79$, and $y = 14$

$\therefore$ No. of Fe^{2+} ions, $x = 79$ and

$\therefore$ No. of Fe^{3+} ions, $y = 14$

$\therefore$ % of iron present as $Fe^{3+} = \frac{14}{79+14} \times 100 = 15.05\%$

10. **(c) :** The product '*X*' is phenolphthalein that gives pink colour with NaOH.



11. **(d) :** (i) $[Cu(NH_3)_3Cl]$ $[PtCl_3(NH_3)]$

(ii) $[Cu(NH_3)Cl_3]$ $[Pt(NH_3)_3Cl]$

(iii) $[CuCl_4]$ $[Pt(NH_3)_4]$

(iv) $[Cu(NH_3)_2Cl_2]$ $[Pt(NH_3)_2Cl_2]$

12. **(c) :** $p_A = p_A^\circ \times X_A$ = Total pressure $\times$ Y_A

$p_B = p_B^\circ \times X_B$ = Total pressure $\times$ Y_B

$$\therefore \quad \frac{p_B^\circ X_B}{p_A^\circ X_A} = \frac{Y_B}{Y_A}, \quad \frac{p_B^\circ (1-X_A)}{p_A^\circ X_A} = \frac{1-Y_A}{Y_A}$$

$$\text{or,} \quad \frac{1}{X_A} - 1 = \frac{p_A^\circ}{p_B^\circ}\left(\frac{1}{Y_A} - 1\right) = \frac{p_A^\circ}{p_B^\circ}\frac{1}{Y_A} - \frac{p_A^\circ}{p_B^\circ}$$

$$\frac{1}{X_A} = \frac{p_A^\circ}{p_B^\circ} \cdot \frac{1}{Y_A} + \left(1 - \frac{p_A^\circ}{p_B^\circ}\right) = \frac{p_A^\circ}{p_B^\circ} \cdot \frac{1}{Y_A} + \frac{p_B^\circ - p_A^\circ}{p_B^\circ}$$

This is equation of straight line.

$$\text{Slope} = \frac{p_A^\circ}{p_B^\circ}, \quad \text{Intercept} = \frac{p_B^\circ - p_A^\circ}{p_B^\circ}$$

13. **(a)**

14. **(b) :** '*A*' is PCl_5 and '*B*' is PCl_3.

$P_4 + 10Cl_2 \longrightarrow 4PCl_5$

$P_4 + 6Cl_2 \longrightarrow 4PCl_3$

When '*A*' and '*B*' are hydrolysed.

$$\underset{\substack{(A)\\ \text{Phosphorus}\\ \text{pentachloride}}}{PCl_5} + 4H_2O \longrightarrow \underset{\substack{\text{Phosphoric}\\ \text{acid}}}{H_3PO_4} + 5HCl$$

$$\underset{\substack{(B)\\ \text{Phosphorus}\\ \text{trichloride}}}{PCl_3} + 3H_2O \longrightarrow \underset{\substack{\text{Phosphorous}\\ \text{acid}}}{H_3PO_3} + 3HCl$$

15. **(d) :** Let volume of HCl neutralised by NaOH = V_1

$N_1V_1 = N_2V_2$; $0.1 \times V_1 = 0.2 \times 30$; $V_1 = 60$ mL

Total volume of HCl = 100 mL

(100 – 60) = 40 mL 0.1 N HCl is now neutralised by 0.25 N KOH

$N_1V_1 = N_2V_{2(KOH)} = 0.1 \times 40 = 0.25 \times V_2$;

$V_2 = 16$ mL.

CBSE warm-up!

CLASS-XII

Practice questions for CBSE Exams as per the reduced syllabus, latest pattern and marking scheme issued by CBSE for the academic session 2020-21.

Practice Paper 2021

Time Allowed : 3 hours
Maximum Marks : 70

General Instructions : Read the following instructions carefully.

(a) There are 33 questions in this question paper. All questions are compulsory.
(b) Section A : Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
(c) Section B : Q. No. 17 to 25 are short answer questions and carry 2 marks each.
(d) Section C : Q. No. 26 to 30 are short answer questions and carry 3 marks each.
(e) Section D : Q. No. 31 to 33 are long answer questions carrying 5 marks each.
(f) There is no overall choice. However, internal choices have been provided.
(g) Use of calculators and log tables is not permitted.

SECTION-A (OBJECTIVE TYPE)

1. Read the passage given below and answer the following questions :

Colloidal particles shows various properties like mechanical properties (*i.e.*, Brownian movement, sedimentation, diffusion), optical properties (Tyndall effect), electrical properties (electrophoresis and electro-osmosis). Colloidal solutions too exhibit colligative properties such as osmotic pressure, lowering of vapour pressure, depression in freezing point and elevation in boiling point.

The physical properties shown by colloidal particles are heterogeneity, filterability (can pass through ordinary filter papers as the size of the pores of filter paper is larger) non-setting nature, showing colour. Colour of the colloidal solution is not always as the colour of the substances in bulk.

The colour depends on size and shape of colloidal particles, wavelength of source, nature of colloidal solution and method of preparation.

The following questions are multiple choice questions. Choose the most appropriate answer.

(i) Which of the following statements are correct?
(i) On the application of an electric field, the particles of lyophobic sol may move in both directions or not move at all.
(ii) Surface tension of lyophobic sols is similar to that of the dispersion medium.
(iii) Electro-osmosis is the movement of the particles of dispersion medium under the influence of an electric field.
(a) (i), (ii) and (iii)
(b) (i) and (iii)
(c) (ii) and (iii)
(d) (i) and (ii)

(ii) Tyndall effect in a colloid is due to
(a) interference of light (b) intensity of light
(c) reflection of light (d) scattering of light.

(iii) The simplest way to check whether a system is colloidal is by
(a) Tyndall effect (b) Brownian movement
(c) electrodialysis
(d) measuring particle size.

OR

The presence of electric charge on colloidal particles is indicated by
(a) osmosis (b) dialysis
(c) electrolysis (d) electrophoresis.

(iv) Separation of colloidal particles from those of molecular dimension with electricity is known as
(a) electrolysis (b) electrophoresis
(c) electrodialysis (d) none of these.

2. Read the passage given below and answer the following questions :

Proteins are polypeptides with a biological function. The sequence of amino acids in protein is called its primary structure. The bond between C and N is somewhat shorter than a normal CN single bond because of mesomery with the C = O double bond. Each position in the primary structure can be occupied by any of the 20 common amino acids, the possible number of combination is huge. The secondary structure of protein in any regular, repetitive folding pattern in the molecule. It is stabilised by hydrogen bonds between amino and keto-groups of the peptide bonds, which carry a partial positive and negative charge, respectively.

Two secondary structures of proteins are,

1. α - helix : The α-helix, a common structural modification of proteins, consists of a right handed helix with a repeat length of 3.6 amino acid resides per helical turn.

2. β - strand : In the β - strand, the polypeptide backbone is stretched out to nearly maximum extension and then laid side by side which are held together by intermolecular hydrogen bonds. Several strands are aligned either in a parallel or antiparallel fashion.

In these questions (Q. No. i - iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choice.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

(i) Assertion : β - pleated sheet structure of protein shows maximum extension.
Reason : Intermolecular hydrogen bonding is present in them.

(ii) Assertion : All proteins have three dimensional structures.
Reason : Primary structures of protein are sequence of amino acids.

OR

Assertion : Insulin is water soluble.
Reason : Insulin is a globular protein.

(iii) Assertion : Peptides are composed of amino acids joined by amide bonds.
Reason : Amide bonds do not participate in hydrogen bonding.

(iv) Assertion : Helical structure is a secondary structure of proteins.
Reason : Helical structure is stablised by hydrogen bonding.

Following questions (Q. No. 3 - 11) are multiple choice questions carrying 1 mark each :

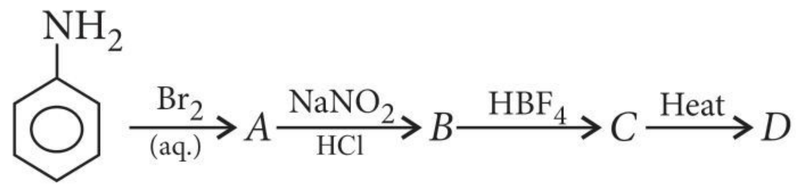
3. Saturated solution of KNO_3 is used to make 'salt bridge' because
(a) velocity of K^+ is greater than that of NO_3^-
(b) velocity of NO_3^- is greater than that of K^+
(c) velocities of both K^+ and NO_3^- are nearly the same
(d) KNO_3 is highly soluble in water.

4. Hydrogen iodide cannot be prepared by the action of conc. H_2SO_4 on potassium iodide because
(a) HI is stronger reducing agent than H_2SO_4
(b) HI is more volatile than H_2SO_4
(c) H_2SO_4 is an oxidising agent
(d) H_2SO_4 forms complex.

OR

When I_2 is dissolved in CCl_4 the colour that results is
(a) brown (b) violet
(c) colourless (d) bluish green.

5. The product '*D*' in the following sequence of reactions is



(a) 2, 4, 6-tribromofluorobenzene
(b) fluorobenzene
(c) *p*-bromofluorobenzene
(d) tribromobenzene.

OR

The IUPAC name of a tertiary amine in which one methyl, one ethyl and one *n*-propyl group is attached to nitrogen is
(a) *N*-methyl-*N*-ethylpropanamine
(b) *N*-ethyl-*N*-methylaminopropane
(c) *N*-ethyl-*N*-methylpropanamine
(d) *N*-methyl-*N*-ethylaminopropane.

6. Which of the following statements is not correct?
(a) 5% aqueous solutions of NaCl and KCl are said to be isomolar.
(b) 1 M sucrose solution and 1 M glucose solution are isotonic.
(c) Molecular mass of acetic acid and benzoic acid is higher than normal mass in cryoscopic methods.
(d) For the same solution, $\frac{\Delta T_b}{\Delta T_f} = \frac{K_b}{K_f}$.

7. The metals of group-12 are softer than other transition metals because
(a) group-12 metals have a cage-like structure
(b) group-12 metals have high ionisation energies
(c) *s*- as well as *d*-electrons take part in metallic bonding
(d) *d*-electrons do not take part in metallic bonding.

8. The two main differences between RNA and DNA are
(a) ribose sugar and thymine in RNA
(b) deoxyribose sugar and uracil in DNA
(c) ribose sugar and uracil in RNA
(d) deoxyribose sugar and guanine in DNA.

OR

Which of the following statements is incorrect about proteins?
(a) They do not contain polypeptide linkages.
(b) Many of them are enzymes.
(c) They are nitrogenous organic compounds of high molecular masses.
(d) On hydrolysis by enzymes, they give amino acids.

9. Which of the following isomers will give white precipitate with $BaCl_2$ solution?
(a) $[Co(NH_3)_5SO_4]Br$ (b) $[Co(NH_3)_5Br]SO_4$
(c) $[Co(NH_3)_4(SO_4)_2]Br$
(d) $[Co(NH_3)_4Br(SO_4)]$

OR

Hexaamminenickel(II) hexanitrocobaltate(III) can be written as
(a) $[Ni(NH_3)_6]_2[Co(NO_2)_6]_3$
(b) $[Ni(NH_3)_6]_3[Co(NO_2)_6]_2$
(c) $[Ni(NH_3)_6]\ [Co(NO_2)_6]$
(d) $[Ni(NH_3)_6(NO_2)_6]Co$

10. The IUPAC name of $(CH_3)_2CH - CH_2 - CH_2Br$ is
(a) 1-bromopentane
(b) 1-bromo-3-methylbutane
(c) 2-methyl-4-bromobutane
(d) 2-methyl-3-bromopropane.

11. The number of unpaired electrons in gaseous species of Mn^{3+}, Cr^{3+} and V^{3+} respectively are _____ and the most stable species is _____ .
(a) 4, 3 and 2 ; V^{3+} (b) 3, 3 and 2 ; Cr^{3+}
(c) 4, 3 and 2 ; Cr^{3+} (d) 3, 3 and 3; Mn^{3+}

In the following questions (Q. No. 12 - 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

12. **Assertion :** Cr^{2+} is reducing and Mn^{3+} is oxidising.
Reason : Cr^{2+} and Mn^{3+} have d^4 configuration.

13. **Assertion :** Anisole undergoes electrophilic substitution at *ortho* and *para*-positions.
Reason : Anisole is less reactive than phenol towards electrophilic substitution reactions.

OR

Assertion : *tert*-Butyl methyl ether on cleavage with HI at 373 K gives *tert*-butyl iodide and methanol.
Reason : The reaction occurs by S_N2 mechanism.

14. **Assertion :** Pressure does not have any effect on solubility of solids in liquids.
Reason : Solids and liquids are highly incompressible.

15. **Assertion :** Most carboxylic acids exist as dimers in the vapour phase or in aprotic solvents.
Reason : Higher carboxylic acids are practically insoluble in water due to the increased hydrophobic interaction of hydrocarbon part.

16. **Assertion :** For the reaction,
$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$, Rate $= k[CHCl_3][Cl_2]^{½}$
Reason : Rate of reaction is always equal to the sum of the stoichiometric coefficients of the reacting species in a balanced chemical equation.

SECTION-B

The following questions, Q. No. 17 – 25 are short answer type and carry 2 marks each.

17. Explain the following :
(i) Sulphur exhibits tendency for catenation but oxygen does not.
(ii) Why HF acid is stored in wax coated glass bottles?

18. The outer electronic configuration of two members of the lanthanoids are as follows :
$4f^1\ 5d^1\ 6s^2$ and $4f^7\ 5d^0\ 6s^2$.
What are their atomic numbers? Predict the oxidation states exhibited by these elements in their compounds.

OR

Describe the variability of oxidation states in the first row of the transition elements (Sc – Cu) and indicate the general trend.

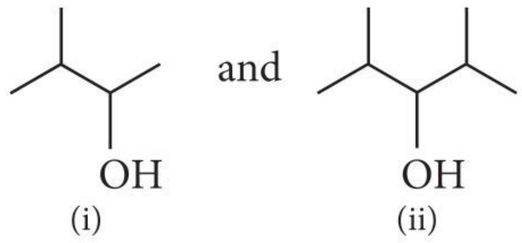
19. The decomposition of NH_3 on platinum surface, $2NH_{3(g)} \xrightarrow{Pt} N_{2(g)} + 3H_{2(g)}$ is a zero order reaction with $k = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}. What are the rates of production of N_2 and H_2?

20. The specific conductance of $N/50$ solution of a cell of KCl at 25°C is 0.002765 mho cm^{-1}. If the resistance of a cell containing this solution is 400 ohm, find out the cell constant.

21. (a) Which of the following is more stable complex and why?
$[Co(NH_3)_6]^{3+}$ and $[Co(en)_3]^{3+}$
(b) Arrange the following complexes in the increasing order of conductivity of their solution :
$[Co(NH_3)_3Cl_3]$, $[Co(NH_3)_4Cl_2]Cl$, $[Co(NH_3)_6]Cl_3$, $[Co(NH_3)_5Cl]Cl_2$

22. Explain the following :
(i) Pyranose structure of glucose.
(ii) Amino acids behave like salts rather than simple amines or carboxylic acids.

23. (a) Identify the chiral molecule in the following pair :



(i) (ii)

(b) Write the structure of the alkene formed by dehydrohalogenation of 1-bromo-1-methylcyclohexane with alcoholic KOH.

OR

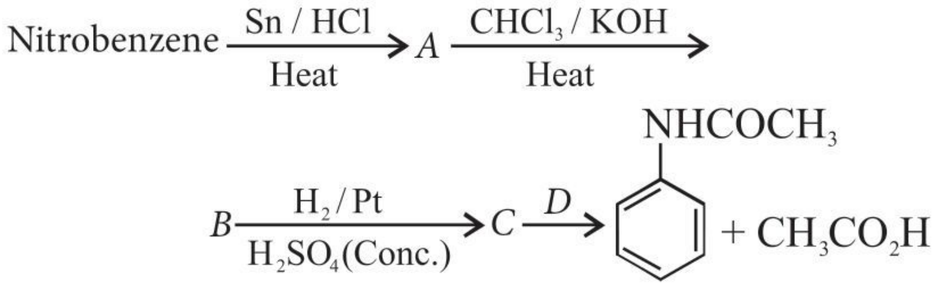
Write the major product(s) in the following reactions :

(i) $2CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3 \xrightarrow[\text{Dry ether}]{Na}$

(ii) $CH_3-CH_2-Br \xrightarrow{AgCN}$

24. (a) How is the following conversion carried out : Anisole to *p*-bromoanisole?
(b) Give mechanism of preparation of ethoxyethane from ethanol.

25. Write the structure of the reagents/organic compounds of *A* to *D* in the following sequence of reactions :



OR

How would you achieve the following conversions :
(i) Nitrobenzene to aniline.
(ii) An alkyl halide to a quaternary ammonium salt.

SECTION-C

Q. No. 26 - 30 are short answer type II carrying 3 marks each.

26. How would you obtain the following :
(i) Benzoquinone from phenol
(ii) 2-Methylpropan-2-ol from methyl magnesium bromide
(iii) Propan-2-ol from propene ?

27. **(a)** Explain why

(i) 4% NaOH solution (mass/volume) and 6% urea solution (mass/volume) are equimolar but not isotonic.

(ii) A solution of chloroform and acetone shows negative deviation from Raoult's law.

(b) Define Henry's Law.

OR

Vapour pressures of chloroform ($CHCl_3$, 119.5 g mol^{-1}) and dichloromethane (CH_2Cl_2, 85 g mol^{-1}) at 298 K are 200 mm Hg and 415 mm Hg respectively. Calculate

(a) vapour pressure of the solution prepared by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at 298 K and

(b) mole fraction of each component in vapour phase.

28. **(a)** Explain why fluorine forms only one oxoacid, HOF.

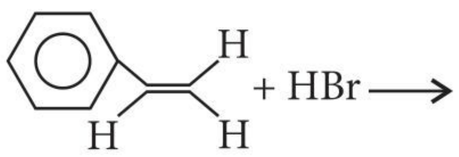
(b) Arrange the following in the order of property indicated for each set :

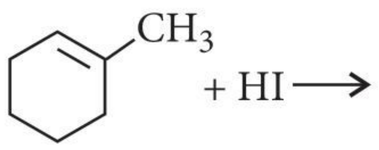
(i) F_2, Cl_2, Br_2, I_2 – increasing bond dissociation enthalpy

(ii) HF, HCl, HBr, HI – increasing acid strength

(iii) H_2O, H_2S, H_2Se, H_2Te – increasing volatility

29. Complete the equations for the following reactions :

(i) 

(ii) 

(iii) 

OR

Compound '*A*' with molecular formula C_4H_9Br is treated with aqueous KOH solution. The rate of this reaction depends upon the concentration of the compound '*A*' only. When another optically active isomer '*B*' of this compound was treated with aqueous KOH solution, the rate of reaction was found to be dependent on concentration of compound and KOH both.

(i) Write down the structural formula of both compounds '*A*' and '*B*'.

(ii) Out of these two compounds, which one will be converted to the product with inverted configuration.

30. The following rate data was obtained at 300 K for the reaction $2A + B \rightarrow C + D$:

Expt.	$[A]$/mol L^{-1}	$[B]$/mol L^{-1}	Rate of formation of D/mol L^{-1} s^{-1}
1.	0.1	0.1	6.0×10^{-3}
2.	0.3	0.2	7.2×10^{-2}
3.	0.3	0.4	2.88×10^{-1}
4.	0.4	0.1	2.4×10^{-2}

Find the rate law for the given reaction.

SECTION-D

Q. No. 31 - 33 are long answer type carrying 5 marks each.

31. **(a)** Describe the following giving a chemical equation for each :

(i) Cannizzaro's reaction.

(ii) *Trans*-esterification.

(b) Why are carboxylic acids more acidic than alcohols or phenols although all of them have hydrogen atom attached to a oxygen atom (—O—H)?

OR

(a) Write the reactions with conditions to bring about the following conversions :

(i) Benzaldehyde to benzyl alcohol.

(ii) Toluene to benzaldehyde.

(iii) Propanone to propene.

(b) To illustrate the following write one chemical reaction in each case :

(i) Etard reaction.

(ii) Wacker's process for converting ethylene to ethanal.

32. **(i)** Using crystal field theory, draw energy level diagram, write electronic configuration of the central metal atom/ion and determine the magnetic moment value in the following :

(a) $[CoF_6]^{3-}$ **(b)** $[FeF_6]^{3-}$ **(c)** $[Fe(CN)_6]^{4-}$

(ii) $FeSO_4$ solution mixed with $(NH_4)_2SO_4$ solution in 1:1 molar ratio gives the test of Fe^{2+} ion but $CuSO_4$ solution mixed with aqueous ammonia in 1 : 4 molar ratio does not give the test of Cu^{2+} ion. Explain why?

OR

(a) What will be the correct order of absorption of wavelength of light in the visible region for the complexes : $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$ and

18+

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$[Co(H_2O)_6]^{3+}$? Give reason.

(b) For the complex $[Fe(en)_2Cl_2]Cl$, answer the following :

(i) Oxidation number of iron.

(ii) Hybrid orbitals and shape of the complex.

(iii) Number of number of bidentate ligands.

(iv) Number of monodentate ligands.

(v) Name of the complex.

33. (i) What is the coordination number of atoms in a **(a)** *bcc* structure and **(b)** *fcc* structure?

(ii) The unit cell of an element of atomic mass 108 u and density 10.5 g cm^{-3} is a cube with edge length, 409 pm. Find the type of unit cell of the crystal.

[Given : Avogadro's constant = 6.022×10^{23} mol^{-1}]

(iii) If NaCl is doped with 10^{-3} mole percent $SrCl_2$, what will be the concentration of cation vacancies?

($N_A = 6.022 \times 10^{23}$ mol^{-1})

OR

(i) What is the formula of a compound in which the element *Y* forms *ccp* lattice and atoms of *X* occupy $1/3^{rd}$ of tetrahedral voids?

(ii) An element crystallises in a *bcc* lattice with cell edge of 500 pm. The density of the element is 7.5 g cm^{-3}. How many atoms are present in 300 g of the element?

(iii) ZnO turns yellow on heating. Why?

SOLUTIONS

1. (i) (c) : On application of an electric field the particles of a lyophobic sol move in only one direction due to similar charge on the colloidal particles.

(ii) (d)

(iii) (a) : Tyndall effect is the simplest way to check colloidal system since path becomes visible due to scattering of light.

OR

(d) : In electrophoresis, colloidal particles move to the oppositely charged electrode under the influence of an electric field.

(iv) (c) : The process is known as electrodialysis.

2. (i) (b) : In β-pleated sheet structure, the polypeptide chains are held together by intermolecular H-bonds. Extension and contraction of β-pleated sheet structure of protein depends on the size of *R*.

(ii) (d) : All proteins do not have three dimensional structures. Structure of proteins are classified as primary, secondary, tertiary and quaternary structure and only tertiary structure is three dimensional. The sequence in which the amino acids are arranged in a protein is called primary structure of protein.

OR

(b) : Insulin is a globular protein. This protein has three-dimensional folded structure. These are stabilised by internal hydrogen bonding, hence, they are water soluble.

(iii) (c)

(iv) (b) : The hydrogen bonding plays important role in secondary structure.

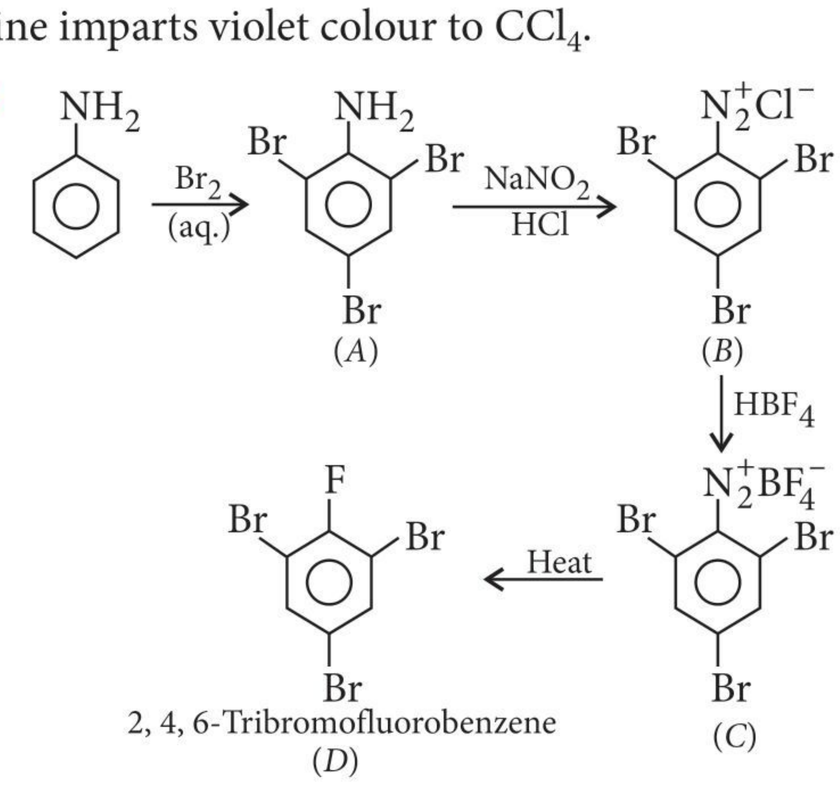
3. (c) : The salt bridge possesses the electrolyte having nearly same ionic mobilities of its cation and anion.

4. (c) : HI cannot be prepared by KI + H_2SO_4 (conc.) because, H_2SO_4 is an oxidising agent which oxidises HI to I_2.

OR

(b) : Iodine imparts violet colour to CCl_4.

5. (a) :



OR

(c)

6. (a)

7. (d) : Metals of group-12 are softer than other transition metals due to comparatively weak metallic bond since their *d*-electrons do not take part in metallic bonding.

8. (c) : RNA contains ribose sugar and uracil while DNA contains deoxyribose sugar and thymine.

OR

(a)

9. (b)

OR

(b)

10. (b)

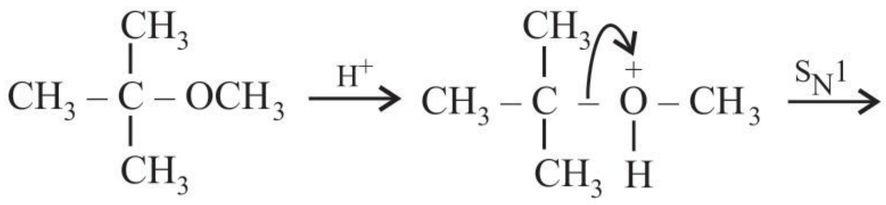
11. (c) : $Mn^{3+} = 3d^4 = 4$ unpaired electrons, $Cr^{3+} = 3d^3 = 3$ unpaired electrons, $V^{3+} = 3d^2 = 2$ unpaired electrons. Cr^{3+} is most stable out of these in aqueous solution because it has half-filled t_{2g} level (*i.e.*, t_{2g}^3).

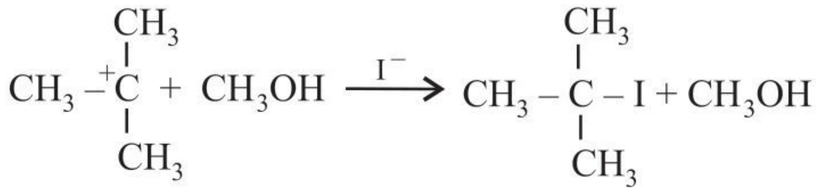
12. (b) : Cr^{2+} is reducing as its configuration changes from d^4 to d^3 (half-filled t_{2g}). The change from Mn^{3+} to Mn^{2+} results in the half-filled d^5 configurations which has extra stability.

13. (b) : Methoxy group in anisole is *ortho*, *para*-directing and activates the aromatic ring towards electrophilic substitution.

OR

(c) The reaction occurs by S_N1 mechanism:





If the reaction have been occurred by S_N2 mechanism, methyl iodide and *tert*-butyl alcohol would have been produced.

14. (a)

15. (b)

16. (c) : Rate of reaction depends upon the experimental conditions such as concentration of reactants, temperature and catalyst. It may or may not be equal to the stoichiometric coefficients of the reacting species in a balanced chemical equation.

17. (i): Single O—O bond is weaker than S—S bond because of high interelectronic repulsions between the lone pair and bond pair of O—O bond, as a result catenation property is weaker in oxygen.

(ii) : HF does not attack wax but attacks sodium silicate which is the main constituent of glass. As a result, the glass bottles are slowly corroded or eaten up.

$Na_2SiO_3 + 6HF \longrightarrow Na_2SiF_6 + 3H_2O$

18. The configuration $4f^15d^16s^2$ corresponds to Ce(Z = 58).

It exhibits oxidation states $Ce^{3+}(4f^1)$ and Ce^{4+} $(4f^0)$.

The configuration $4f^75d^06s^2$ corresponds to Eu ($Z = 63$).

It exhibits oxidation states $Eu^{2+}(4f^7)$ and Eu^{3+} $(4f^6)$.

OR

In the first row of transition elements the highest oxidation state increases with increase in atomic number, reaches a maximum in the middle and then starts decreasing. For example, manganese shows the oxidation state of +7. In general the minimum oxidation state shown by any transition element is equal to the number of *ns*-electrons. For the first five members of transition series the highest oxidation state is equal to the sum of *ns* and $(n-1)d$ electrons. For remaining five elements the maximum oxidation state is not related to the electronic configuration. The most common oxidation state is +2 (except scandium). The most common oxidation states of transition elements differ from each other by unity.

19. $2NH_{3(g)} \overset{Pt}{\rightleftharpoons} N_{2(g)} + 3H_{2(g)}$

$k = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}

The order of reaction is zero *i.e.*, Rate = k [Reactant]^0

Rate = $2.5 \times 10^{-4} \times 1 = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}

$$\therefore \quad \text{Rate of reaction} = \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt}$$

The rate of formation of $N_2 = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}

$$\text{Again, } 2.5 \times 10^{-4} = \frac{1}{3}\frac{d[H_2]}{dt}$$

$$\therefore \quad \frac{d[H_2]}{dt} = 7.5 \times 10^{-4} \text{ mol } L^{-1} \text{ } s^{-1}$$

Therefore, rate of formation of $H_2 = 7.5 \times 10^{-4}$ mol L^{-1} s^{-1}

20. Given, $\kappa = 0.002765$ mho cm^{-1}, $R = 400$ ohm

$$\kappa = \frac{1}{R} \times \frac{l}{a} \quad \left(\frac{l}{a} = \text{cell constant}\right)$$

$$0.002765 = \frac{1}{400} \times \text{cell constant}$$

$\therefore$ Cell constant = 1.106 cm^{-1}

Quotable Quote

"Science never solves a problem without creating ten more."

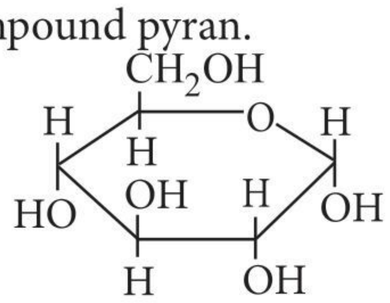
George Bernard Shaw

21. (a) $[Co(en)_3]^{3+}$ is more stable complex than $[Co(NH_3)_6]^{3+}$ due to chelate effect as it forms rings.

(b) $[Co(NH_3)_3Cl_3] < [Co(NH_3)_4Cl_2]Cl < [Co(NH_3)_5Cl]Cl_2 < [Co(NH_3)_6]Cl_3$

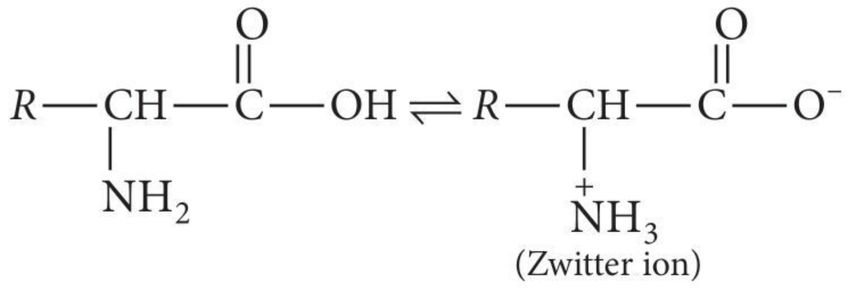
Conductivity depends on the number of ions produced in the solution. In the order, complexes produce 1, 2, 3 and 4 ions respectively.

22. (i) : The six membered cyclic structure of glucose is called pyranose structure (α– or β –), in analogy with heterocyclic compound pyran.



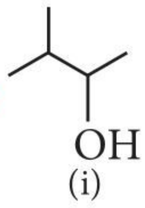
α-*D*-(+)-Glucopyranose

(ii) : Salt like behaviour of amino acids is due to the presence of both acidic and amino group in the same molecule. In aqueous solution, the carboxyl group loses a proton and amino group accepts a proton to form a dipolar ion or zwitter ion.

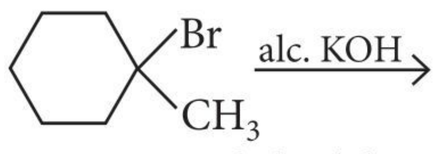


(Zwitter ion)

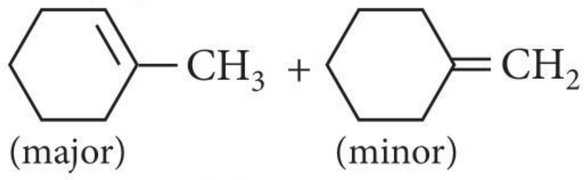
Therefore, they behave like salts rather than simple amines or carboxylic acids.

23. (a) :  is chiral.

(i)

(b) : 

1-Bromo-1-methylcyclohexane

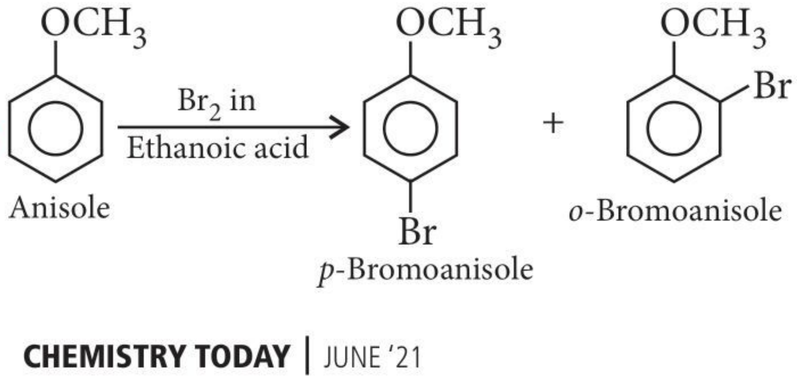


(major) (minor)

OR

(i) : $CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_3$

(ii) : CH_3CH_2NC

24. (a) : 

Anisole *p*-Bromoanisole *o*-Bromoanisole

(b) : Mechanism : The formation of ether from ethanol is nucleophilic bimolecular reaction (S_N2).

Step I : $CH_3-CH_2-\ddot{O}-H + H^+ \longrightarrow CH_3-CH_2-\overset{H}{\overset{|}{\overset{+}{\ddot{O}}}}-H$

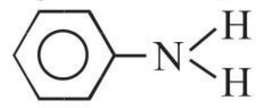
Step II : $CH_3-CH_2-\ddot{O}-H + CH_3-CH_2-\overset{H}{\overset{|}{\overset{+}{\ddot{O}}}}-H \xrightarrow[-H_2O]{}$

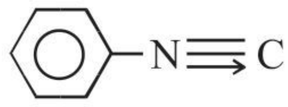
$CH_3-CH_2-\overset{H}{\overset{|}{\overset{+}{\ddot{O}}}}-CH_2-CH_3$

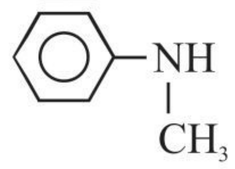
Step III : $CH_3-CH_2-\overset{H}{\overset{|}{\overset{+}{\ddot{O}}}}-CH_2-CH_3 \longrightarrow$

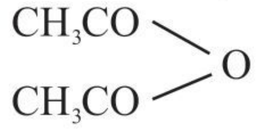
$CH_3-CH_2-O-CH_2-CH_3 + H^+$

25. Structure of reagents/organic compounds :

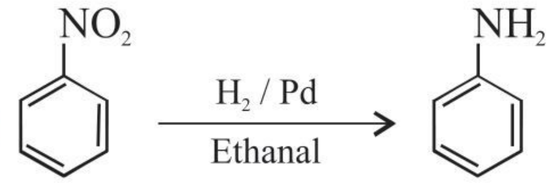
A = Aniline 

B = Phenyl isocyanide 

C = Methyl phenyl amine 

D = Acetic anhydride 

OR

(i) : 

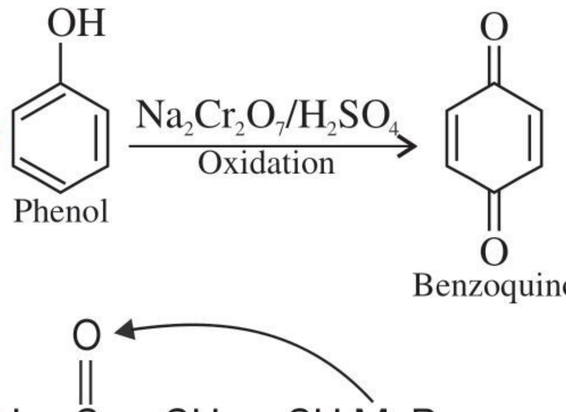
Nitrobenzene Aniline

(ii) : $R-X + NH_3 \xrightarrow[OH^-]{373\ K} RNH_2 \xrightarrow[OH^-]{RX} R_2NH \xrightarrow[OH^-]{RX}$

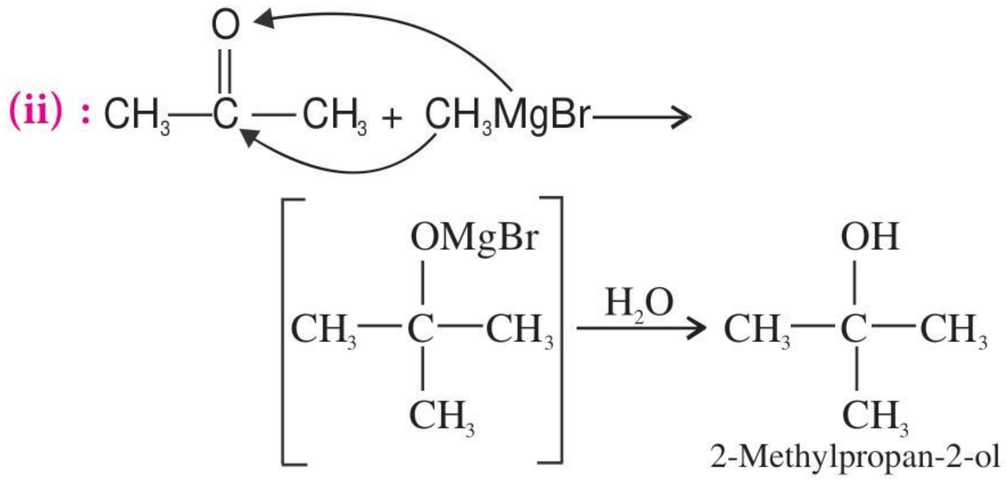
alkyl halide Ammonia 1° amine 2° amine

$R_3N \xrightarrow[OH^-]{RX} R_4N^+X^-$

3° amine Quaternary ammonium salt (4°)

26. (i): 

Phenol Benzoquinone

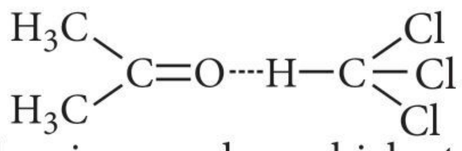
(ii) : 

2-Methylpropan-2-ol

(iii) $CH_3—CH=CH_2 \xrightarrow[\text{Markovnikov's addition}]{H_2O/H_2SO_4} \underset{\text{Propan-2-ol}}{CH_3—\underset{\displaystyle OH}{\underset{|}{CH}}—CH_3}$

27. (a) : (i) Both the solutions 4% NaOH (*W*/*V*) and 6% urea (*W*/*V*) have same concentration (1 M) but these are not isotonic because NaOH undergoes dissociation in solution. Therefore, number of particles in NaOH solution is more than that in urea solution.

(ii) : A mixture of chloroform and acetone shows negative deviation from Raoult's law because chloroform molecule forms H-bonding with acetone molecule. As a result of this *A*—*B* interaction becomes stronger than *A*—*A* and *B*—*B* interactions. This leads to the decrease in vapour pressure and resulting in negative deviation.



(b) : Henry's law is a gas law which states that at the amount of gas that is dissolved in a liquid is directly proportional to the partial pressure of that gas above the liquid when the temperture is kept constnat. The constant of proportionality for this relationship is called Henry's law constant (usually denoted by 'kH').

OR

(a) $P_{total} = p°_1x_1 + p°_2x_2 = p°_{CHCl_3}x_{CHCl_3} + p°_{CH_2Cl_2}x_{CH_2Cl_2}$

Component	Amount	No. of moles	Mole fraction
$CHCl_3$	25.5 g	$\frac{25.5}{119.5} = 0.2134$	$x_{CHCl_3} = \frac{n_{CHCl_3}}{n_{Total}} = 0.312$
CH_2Cl_2	40 g	$\frac{40}{85} = 0.4706$	$x_{CH_2Cl_2} = 1 - x_{CHCl_3} = 0.688$

Vapour pressure due to $CHCl_3$,

$p_{CHCl_3} = p°_{CHCl_3}x_{CHCl_3} = 200 \times 0.312 = 62.4$ mmHg

Vapour pressure due to CH_2Cl_2,

$p_{CH_2Cl_2} = 415 \times 0.688 = 285.52$ mmHg

Total vapour pressure = 62.4 + 285.52 = 347.92 mmHg

(b) Mole fraction of $CHCl_3$ in vapour phase,

$$y_{CHCl_3} = \frac{p_{CHCl_3}}{P_{Total}} = \frac{62.4}{347.92} = 0.1794$$

Mole fraction of CH_2Cl_2 in vapour phase,

$y_{CH_2Cl_2} = 1 - 0.1794 = 0.8205$

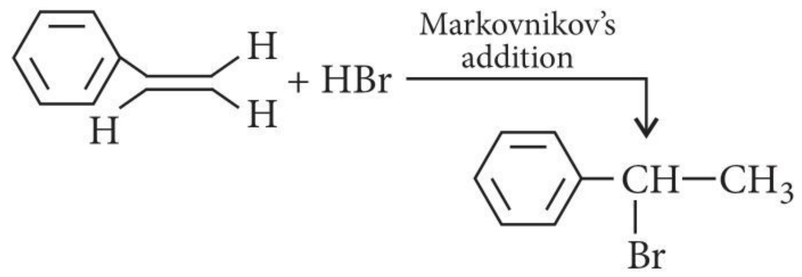
28. (a) Due to high electronegativity and absence of *d*-orbitals, F does not form oxoacids such as HOFO, $HOFO_2$ and $HOFO_3$ in which the oxidation state of F is +3, +5 and +7. It just forms one oxoacid, *i.e.*, HOF in which the oxidation state of F is + 1.

(b) (i) $I_2 < F_2 < Br_2 < Cl_2$

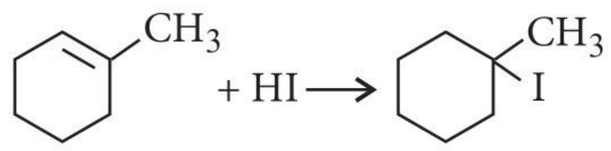
(ii) HF < HCl < HBr < HI

(iii) $H_2S > H_2Se > H_2Te > H_2O$

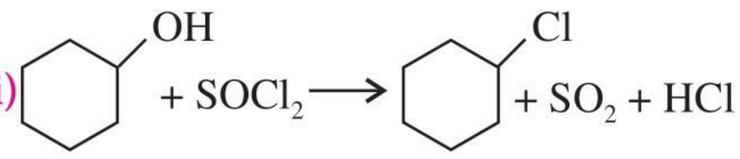
29. (i)



(ii)



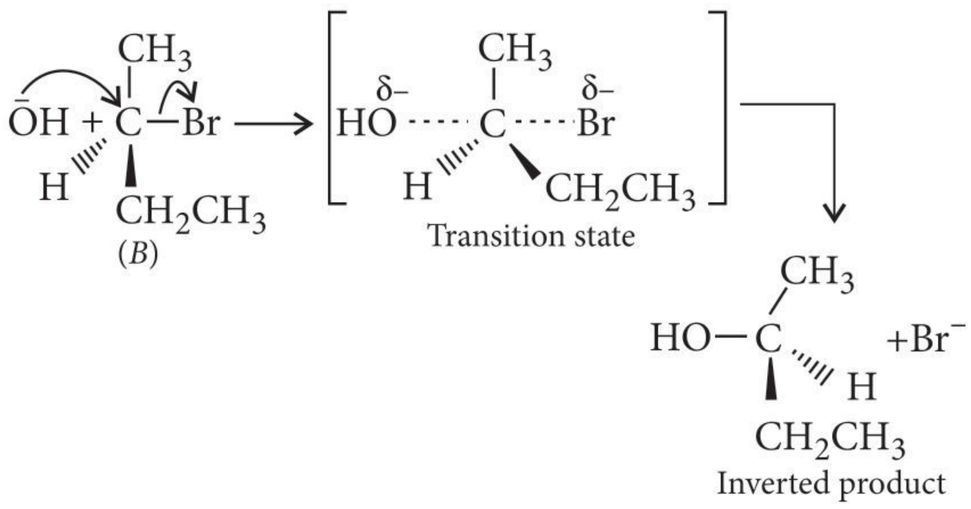
(iii)



OR

(i) : As the rate of reaction depends upon the concentration of compound '*A*' (C_4H_9Br) only therefore, the reaction is proceeded by S_N1 mechanism and the given compound will be tertiary alkyl halide, *i.e.*, 2-bromo-2-methylpropane and the structure of (*A*) is $(CH_3)_3CBr$. Optically active isomer of '*A*' is 2-bromobutane (*B*) and its structural formula is $CH_3CH_2\overset{*}{C}H(Br)CH_3$.

(ii) : The rate of reaction of compound '*B*' depends both upon the concentration of compound '*B*' and KOH. Hence, the reaction follow S_N2 mechanism. In S_N2 reaction, nucleophile attack from, the backside, therefore the product of hydrolysis will have opposite configuration.



30. Suppose order with respect to *A* is *m* and with respect to *B* is *n*. Then the rate law will be

Rate = $k[A]^m[B]^n$

Substituting the value of experiments 1 to 4, we get

Expt. 1 : Rate = $6.0 \times 10^{-3} = k\,(0.1)^m\,(0.1)^n$ ...(i)

Expt. 2 : Rate = $7.2 \times 10^{-2} = k\,(0.3)^m\,(0.2)^n$ ...(ii)

Expt. 3 : Rate = $2.88 \times 10^{-1} = k\,(0.3)^m\,(0.4)^n$ ...(iii)

Expt. 4 : Rate = $2.4 \times 10^{-2} = k\,(0.4)^m\,(0.1)^n$ ...(iv)

Comparing equation (i) and equation (iv)

$$\therefore \quad \frac{(\text{Rate})_1}{(\text{Rate})_4} = \frac{6.0 \times 10^{-3}}{2.4 \times 10^{-2}} = \frac{k(0.1)^m\,(0.1)^n}{k(0.4)^m\,(0.1)^n}$$

$$\text{or,} \quad \frac{1}{4} = \frac{(0.1)^m}{(0.4)^m} = \left(\frac{1}{4}\right)^m$$

$\therefore \; m = 1$

$$\frac{(\text{Rate})_2}{(\text{Rate})_3} = \frac{7.2 \times 10^{-2}}{2.88 \times 10^{-1}} = \frac{k(0.3)^m\,(0.2)^n}{k(0.3)^m\,(0.4)^n}$$

$$\text{or,} \quad \left(\frac{1}{2}\right)^2 = \frac{(0.2)^n}{(0.4)^n} = \left(\frac{1}{2}\right)^n$$

$\therefore \; n = 2$

$\therefore$ Rate law expression is : Rate = $k[A][B]^2$

31. (a) (i) Cannizzaro's reaction : Aldehydes which do not contain α-H atom undergo disproportionation when heated with concentrated (50%) NaOH.

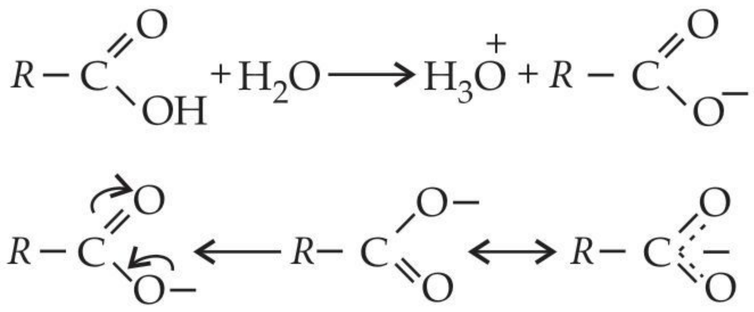
$$\underset{\text{Methanal}}{2\,HCHO} \xrightarrow{50\ \%\ NaOH} \underset{\text{Sodium formate}}{HCOONa} + \underset{\text{Methanol}}{CH_3OH}$$

(ii) Trans-esterification : An ester on reaction with excess of alcohol in the presence of mineral acid forms a new ester.

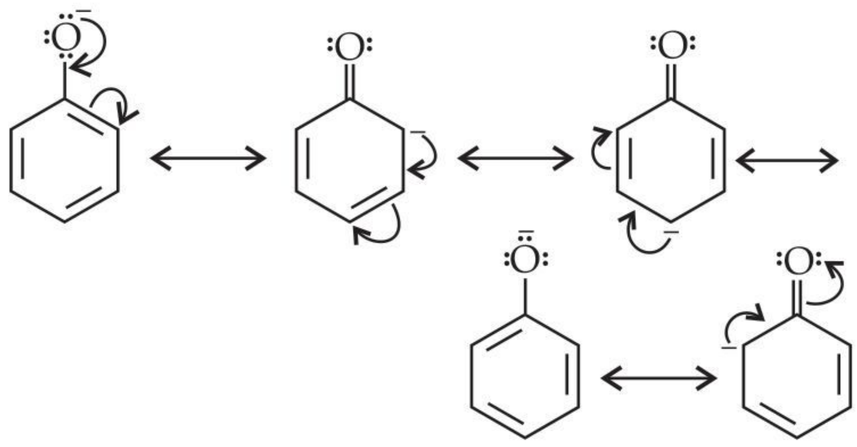
$$\underset{\text{Methyl ethanoate}}{CH_3-\overset{\overset{O}{\|}}{C}-OCH_3} + \underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow{H^+}$$

$$\underset{\text{Ethyl ethanoate}}{CH_3-\overset{\overset{O}{\|}}{C}-OCH_2CH_3} + \underset{\text{Methanol}}{CH_3OH}$$

(b) Carboxylate ion is stabilised by two equivalent resonance structures. Negative charge in these structures is delocalised at more electronegative oxygen atoms.



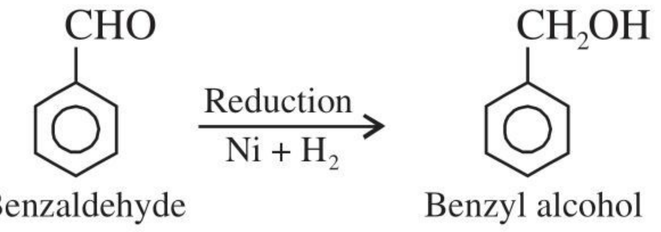
In alcohols, the alkoxide ion is not stabilised by resonance. In phenoxide ion, the resonance structures are non-equivalant and the structures have negative charge on less electronegative carbon atom in all structures except two.



Therefore, carboxylate ion is more stable than phenoxide ion.

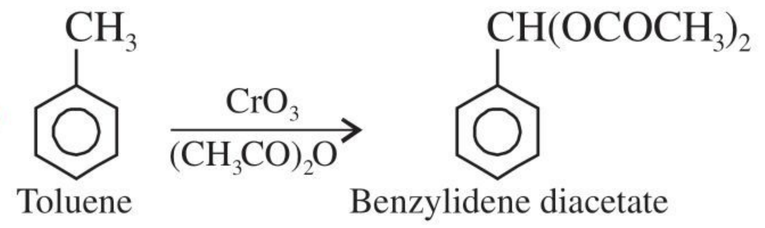
OR

(a) (i)

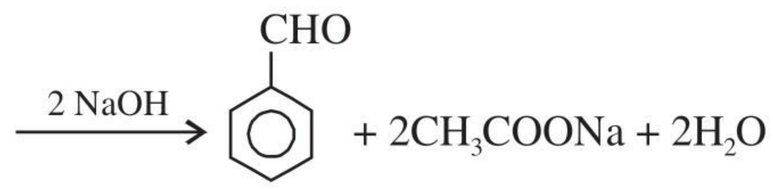


Benzaldehyde — Benzyl alcohol

(ii)

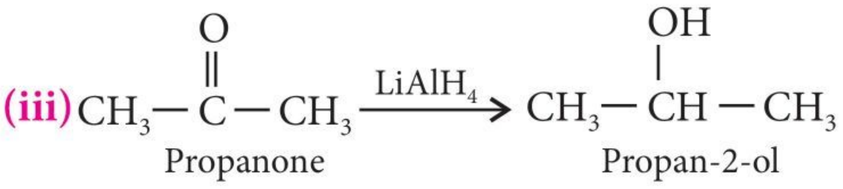


Toluene — Benzylidene diacetate

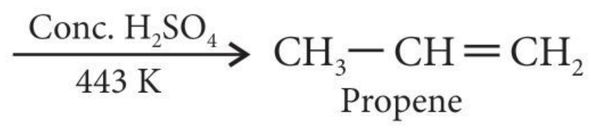


Benzaldehyde

(iii)

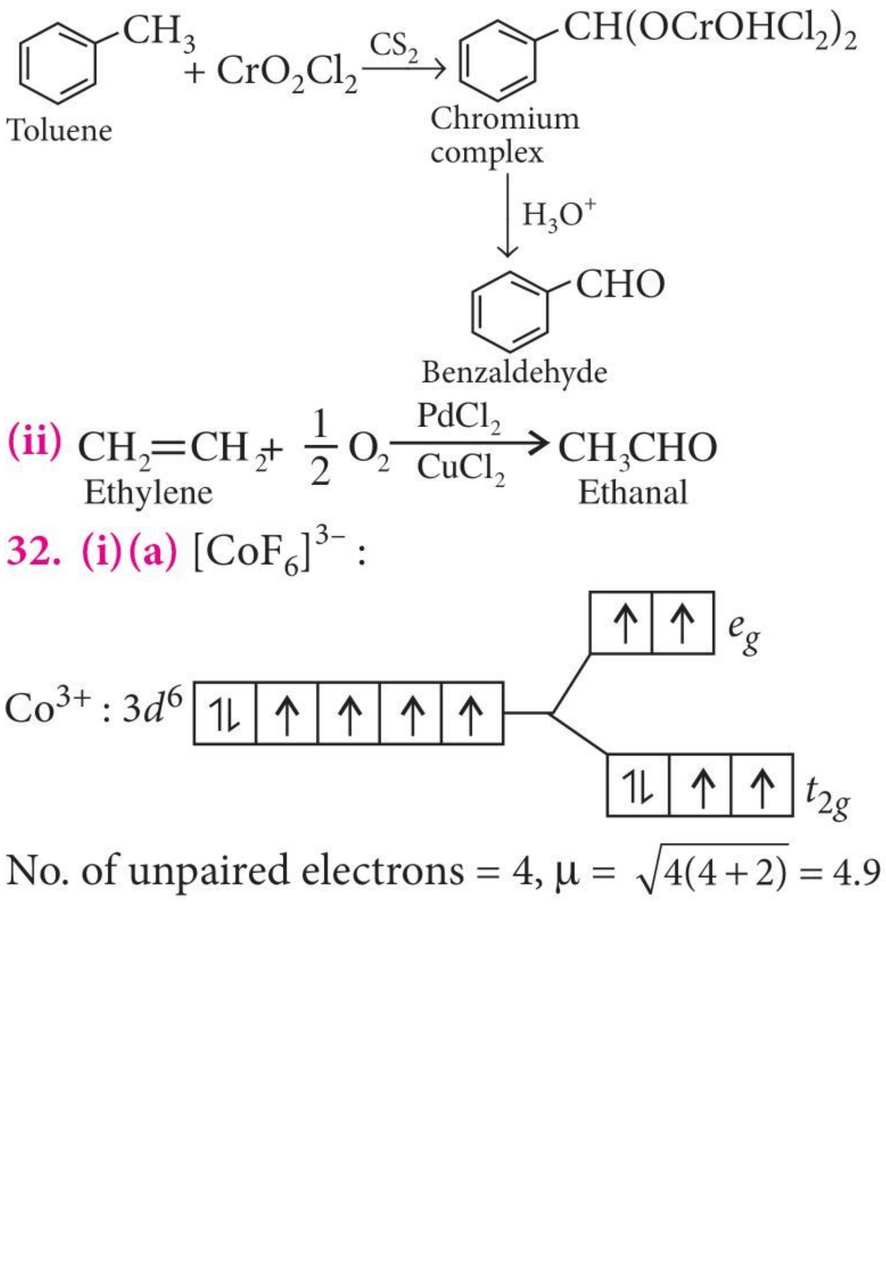


Propanone (Acetone) — Propan-2-ol



Propene

(b) (i) Etard reaction :



Toluene — Benzaldehyde

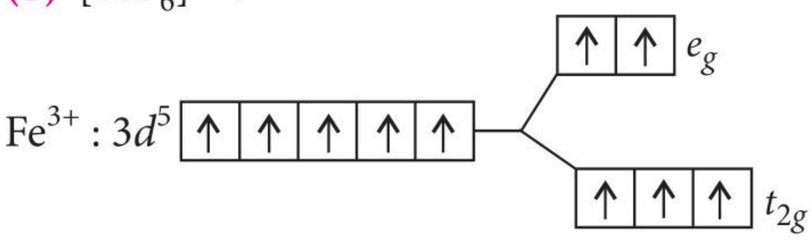
(ii)

Ethylene — Ethanal

32. (i)(a) $[CoF_6]^{3-}$:

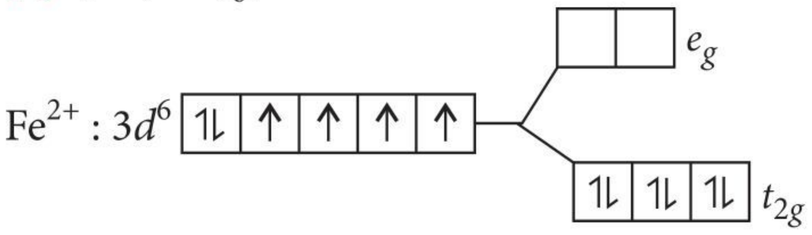
No. of unpaired electrons = 4, $\mu = \sqrt{4(4+2)} = 4.9$ B.M.

(b) $[FeF_6]^{3-}$:



No. of unpaired electrons = 5, $\mu = \sqrt{5(5+2)} = 5.92$ B.M.

(c) $[Fe(CN)_6]^{4-}$:



No. of unpaired electrons = 0, $\mu = 0$

(ii) When $FeSO_4$ and $(NH_4)_2SO_4$ solutions are mixed in 1 : 1 molar ratio, Mohr's salt (a double salt) is formed.

$$FeSO_{4(aq)} + (NH_4)_2SO_{4(aq)} \rightarrow FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$$

$$FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O \rightleftharpoons Fe^{2+}_{(aq)} + 2NH^{+}_{4(aq)} + 2SO^{2-}_{4(aq)} + 6H_2O$$

Because Fe^{2+} ions are formed on dissolution of Mohr's salt, its aqueous solution gives the test of Fe^{2+} ions.

When $CuSO_4$ is mixed with ammonia, following reaction occurs :

$$CuSO_{4(aq)} + 4NH_{3(aq)} \rightarrow [Cu(NH_3)_4]SO_4$$

This complex does not produce Cu^{2+} ion, so the solution of $CuSO_4$ and NH_3 does not give the test of Cu^{2+} ion.

OR

(a) As strength of ligand increases crystal field splitting energy (CFSE) increases.

Order of strength of ligands : $H_2O < NH_3 < CN^-$

Now, $\Delta E = \dfrac{hc}{\lambda}$.

So, as CFSE increases, ΔE increases and λ decreases.

Thus, the correct order of absorption of wavelength of light in the visible region is :

$$[Co(H_2O)_6]^{3+} > [Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-}$$

(b) (i) $[Fe(en)_2Cl_2]Cl : x + 0 \times 2 + (-1) \times 2 + (-1) \times 1 = 0$

$\Rightarrow \quad x = 3$

Oxidation number of iron = +3

(ii) d^2sp^3 hybridisation and octahedral shape.

(iii) 2, Ethylenediamine

(iv) 2, chloride

(v) Dichlorido*bis*(ethane-1,2-diamine)iron(III) chloride

33. (i) (a) 8 **(b)** 12

(ii) Atomic mass, $M = 108$ u, $d = 10.5$ g/cm^3, $a = 409$ pm

We know, $d = \dfrac{Z \times M}{a^3 \times 10^{-30} \times N_A}$ [... a is in pm.]

$$Z = \frac{d \times a^3 \times 10^{-30} \times N_A}{M}$$

$$Z = \frac{10.5 \times (409)^3 \times 10^{-30} \times 6.022 \times 10^{23}}{108} = 4$$

Thus, crystal lattice has *fcc* structure.

(iii) The number of cation vacancies created in the lattice of NaCl is equal to the number of divalent Sr^{2+} ions added.

Concentration of $Sr^{2+} = 10^{-3}$ mol %

$$= \frac{10^{-3}}{100} = 10^{-5} \text{ mol}$$

1 mole of $Sr^{2+} = 6.023 \times 10^{23}$ Sr^{2+} ions

10^{-5} mol of $Sr^{2+} = 6.023 \times 10^{23} \times 10^{-5}$

$= 6.023 \times 10^{18}$ Sr^{2+} ions

OR

(i) No. of Y atoms per unit cell $= \dfrac{1}{8} \times 8 + \dfrac{1}{2} \times 6 = 4$

No. of tetrahedral voids $= 2 \times 4 = 8$

$\therefore$ No. of X atoms $= \dfrac{1}{3} \times 8 = \dfrac{8}{3}$

Formula of the compound = $X_{\frac{8}{3}}Y_4 = X_2Y_3$

(ii) Given, edge length $a = 500$ pm $= 500 \times 10^{-10}$ cm

Mass of substance = 300 g

Number of atoms = ?

Density, $d = 7.5$ g cm^{-3}

Using formula, $d = \dfrac{Z \times M}{N_A \times a^3}$

or $\quad M = \dfrac{d \times N_A \times a^3}{Z}$

$$M = \frac{7.5 \text{ g cm}^{-3} \times 6.022 \times 10^{23} \text{ mol}^{-1} \times (500 \times 10^{-10} \text{ cm})^3}{2}$$

or $\quad M = 282.28$ g mol^{-1}

$$\text{Number of atoms} = \frac{6.022 \times 10^{23} \times 300}{282.28}$$

$= 6.40 \times 10^{23}$ atoms

(iii) Initially ZnO is white in colour at room temperature but on heating it loses oxygen which creates anion vacancy defect and it turns yellow.

$$ZnO \xrightarrow{\text{Heating}} Zn^{2+} + \frac{1}{2}O_2 + 2e^-$$

MONTHLY TEST DRIVE

This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120

PRACTICE PAPER

Time Taken : 60 Min.

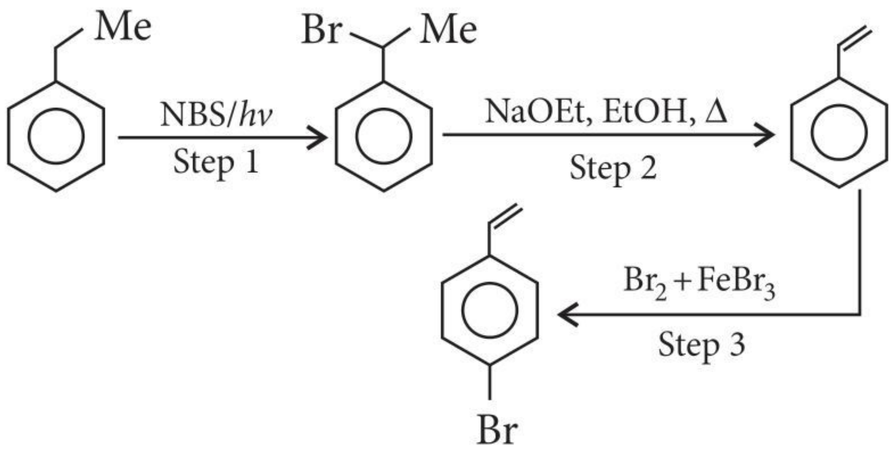
NEET

Only One Option Correct Type

1. Which statement is correct about the oxyacids of phosphorus?
(a) Basicity of both H_3PO_4 and H_3PO_3 is 3.
(b) Acidity of both H_3PO_4 and H_3PO_3 is 3.
(c) Acidity of H_3PO_4 and H_3PO_3 is 3 and 2 respectively.
(d) Basicity of H_3PO_4 and H_3PO_3 is 3 and 2 respectively.

2. Which of the following alcohols is the LEAST soluble in water?
(a) CH_3OH
(b) CH_3CH_2OH
(c) $CH_3(CH_2)_3OH$
(d) $(CH_3)_2CHCH_2OH$

3. In the following reaction, which of the following steps is wrong?



(a) Step 1 (b) Step 2
(c) Step 3 (d) None of these

4. The resistance of 0.01 N solution of an electrolyte was found to be 210 ohm at 298 K, using a conductivity cell of cell constant 0.66 cm^{-1}. The equivalent conductance of solution is
(a) 314.28 mho cm^2 eq^{-1}
(b) 3.14 mho cm^2 eq^{-1}
(c) 314.28 mho^{-1} cm^2 eq^{-1}
(d) 3.14 mho^{-1} cm^2 eq^{-1}

5. Oxidation states of the metal in the minerals haematite and magnetite, respectively are
(a) II, III in haematite and III in magnetite
(b) II, III in haematite and II in magnetite
(c) II in haematite and II, III in magnetite
(d) III in haematite and II, III in magnetite.

6. When MnO_2 is fused with KOH, a coloured compound is formed. Which of the following is the correct pair of compound and its colour?
(a) K_2MnO_4, purple green (b) $KMnO_4$, purple
(c) Mn_2O_3, brown (d) Mn_3O_4, black

7. D-glucose, on treating with methanol in presence of dry HCl gives methyl glucoside according to the following reaction :

$$\text{D-glucose} \xrightarrow{CH_3OH/\text{dry HCl}} \alpha\text{–methyl glucosides and } \beta\text{–methyl glucosides}$$

Mention true (T) and false (F) from the following statements :
S1 : The glucosides do not reduce Fehling's solution.
S2 : The glucosides do not react with hydrogen cyanide or hydroxylamine.
S3 : Behaviour of glucosides as stated in S1 and S2 indicates the absence of free —CHO group.
S4 : The two forms of glucosides are enantiomers.
(a) TTFF (b) FTTT
(c) TTTF (d) TFTF

8. The portion of edge length not occupied by atoms for *scc*, *fcc* and *bcc* are respectively (*a* is edge length)

(a) $0; a\left(1-\frac{\sqrt{3}}{2}\right); a\left(1-\frac{1}{\sqrt{2}}\right)$

(b) $a\left(1-\frac{\sqrt{3}}{2}\right); 0; a\left(2-\frac{1}{\sqrt{2}}\right)$

(c) $0; a\left(1-\frac{1}{\sqrt{2}}\right); a\left(1-\frac{\sqrt{3}}{2}\right)$

(d) $a\,; 2\sqrt{2}\,a\,; \frac{\sqrt{3}}{2}a$

9. The Rubin number which was proposed by Ostwald as an alternative to the gold number in order to measure the protective efficiency of a lyophillic colloid may be defined as the

(a) mass in milligrams of a colloid per 100 c.c. of solution which just prevents the colour change of standard sol of dye Congo - Rubin from red to violet when 0.16 g eq. KCl is added to it.

(b) mass in grams of a colloid per 100 c.c. of solution which just prevents the colour change of standard sol of dye Congo - Rubin from red to violet when 0.1 M KCl is added to it

(c) mass in grams of a colloid per 100 c.c. of solution which just prevents the colour change of standard sol of dye Congo - Rubin from red to violet when 0.2 M KCl is added to it.

(d) mass in grams of a colloid per 100 c.c. of solution which just prevents the colour - change of standard sol of dye Congo - Rubin from red to violet when 1 M KCl is added to it.

10. The following data pertain to a reaction between *A* and *B* :

S.No.	**[*A*]** (mol L^{-1})	**[*B*]** (mol L^{-1})	**Rate** (mol L^{-1} s^{-1})
I	1×10^{-2}	2×10^{-2}	2×10^{-4}
II	2×10^{-2}	2×10^{-2}	4×10^{-4}
III	2×10^{-2}	4×10^{-2}	8×10^{-4}

Which of the following inference(s) can be drawn from the above data?

(i) Rate constant of the reaction is 10^{-4}.

(ii) Rate law of the reaction is $k[A]\,[B]$.

(iii) Rate of reaction increase four times on doubling the concentration of both the reactants.

(a) (i), (ii) and (iii) (b) Only (i) and (ii)

(c) Only (ii) and (iii) (d) Only (iii)

11. Which one of the following statements is true?

(a) In aqueous medium, HF is a stronger acid than HCl.

(b) $HClO_4$ is a weaker acid than $HClO_3$.

(c) HNO_3 is a stronger acid than HNO_2.

(d) H_2PO_3 is a stronger acid than H_2SO_3.

12. On reaction with Cl_2, phosphorus forms two types of halides '*A*' and '*B*'. Halide '*A*' is yellowish white powder but halide '*B*' is colourless oily liquid. Which of the following are their hydrolysis products respectively?

(I) H_3PO_2 (II) H_3PO_4

(III) H_3PO_3 (IV) H_3PO_5

(a) I and II (b) II and III

(c) III and IV (d) I and IV

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of assertion.

(c) If assertion is true but reason is false.

(d) If both assertion and reason are false.

13. **Assertion :** In strongly acidic solutions, aniline becomes more reactive towards electrophilic reagents.

Reason : The amino group being completely protonated in strongly acidic solution, the lone pair of electrons on the nitrogen is available for resonance.

14. **Assertion :** The $[Ni(en)_3]Cl_2$ (*en* = ethylenediamine) has lower stability than $[Ni(NH_3)_6]Cl_2$.

Reason : In $[Ni(en)_3]Cl_2$ the geometry of Ni is trigonal bipyramidal.

15. **Assertion :** Glycine exists as zwitter ion but *o*-and *p*-amino benzoic acid do not.

Reason : Due to the presence of $-NH_2$ and $-COOH$ groups within the same molecule, they neutralise each other and hence α-amino acids exist as dipolar ions or zwitter ions.

JEE MAIN / JEE ADVANCED

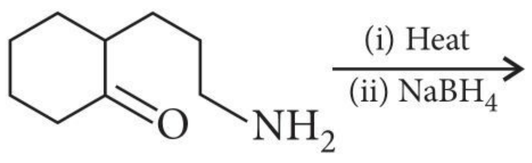
Only One Option Correct Type

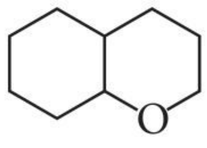
16. Two aqueous solutions *A* and *B*, are separated by a semi-permeable membrane. The osmotic pressure of

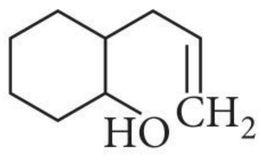
solution *A* immediately begins to decrease. Which of the following statements is true?

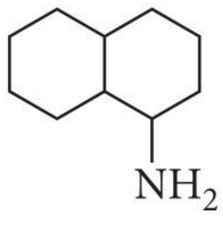
(a) The solvent molecules are moving from the solution of higher osmotic pressure to that of lower osmotic pressure.
(b) The initial osmotic pressure of solution *B* is greater than that of solution *A*.
(c) Solvent molecules are moving from solution *B* into solution *A*.
(d) Both (a) and (b).

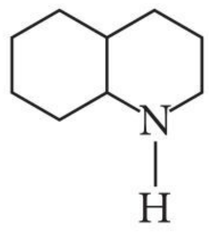
17. Identify the final product.



(a) 

(b) 

(c) 

(d) 

18. Which one of the following is employed as a tranquilizer?

(a) Naproxen
(b) Tetracycline
(c) Chlorpheniramine
(d) Equanil

19. Volatile nature of halogens is because

(a) the halogen molecules are more reactive
(b) the force existing between the molecules are only weak van der Waals' forces
(c) halogen molecules are bounded by strong forces
(d) halogen molecules are bounded by electrostatic forces.

More than One Options Correct Type

20. When O_2 is adsorbed on a metallic surface, electron transfer occurs from the metal to O_2. The true statement(s) regarding this adsorption are

(a) O_2 is physisorbed
(b) heat is released
(c) occupancy of π^*_{2p} of O_2 is increased
(d) bond length of O_2 is increased.

21. Which of the following statements are true about $\diagdown C = O \diagup$ group?

(a) The carbon atom of the carbonyl group is sp^2 hybridized.
(b) The C = O bond length is longer than that of C = C bond length.
(c) The portion of the molecule immediately surrounding the carbonyl group is planar.
(d) None of the above.

22. Aryl halides are less reactive towards nucleophilic substitution reaction as compared to alkyl halides due to

(a) the formation of less stable carbonium ion
(b) resonance stabilisation
(c) the inductive effect
(d) sp^2-hybridised carbon attached to the halogen.

23. The reagents that can be used to convert benzenediazonium chloride to benzene are

(a) $SnCl_2/HCl$
(b) CH_3CH_2OH
(c) H_3PO_2, H_2O
(d) HBF_4

COMEDK UGET 2021

COMEDK UGET 2021 to be rescheduled, registration process extends till July 15

The Consortium of Medical, Engineering and Dental Colleges of Karnataka (COMEDK) postponed the UGET examination. The COMEDK UGET was scheduled to held on June 20. The revised date for COMEDK UGET 2021 will be announced in due course.

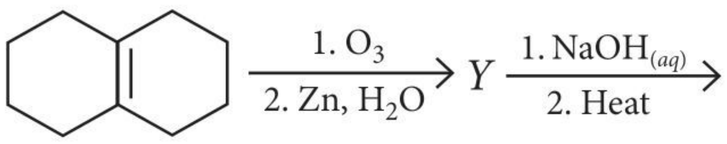
The exam was to be conducted online in over 150 cities across India in over 400 test centres. The last date to apply for the entrance exam has also been extended. The candidates can now register at comedk.org or unigauge.com till July 15. The entrance test will be held for admissions to BE/B.Tech for colleges affiliated with the Karnataka Professional Colleges Foundation Trust and Uni-Gauge member universities.

The test will be for a total of three hours duration. The question paper will be available in the English language only. There will be a total of 180 questions in the test of a total of 180 marks. About 60 questions each will be asked from physics, chemistry, and maths. One mark will be awarded for each correct answer. There is no negative marking for the wrong answers. The Consortium of Medical, Engineering and Dental Colleges of Karnataka (COMEDK) is an autonomous institution that conducts entrance exams and offers admission to the candidates through a centralised counselling process.

For more information visit
www. comedk.org

Integer / Numerical Value Type

24. In the given sequence of reactions, the total number of intramolecular aldol condensation products formed from '*Y*' is

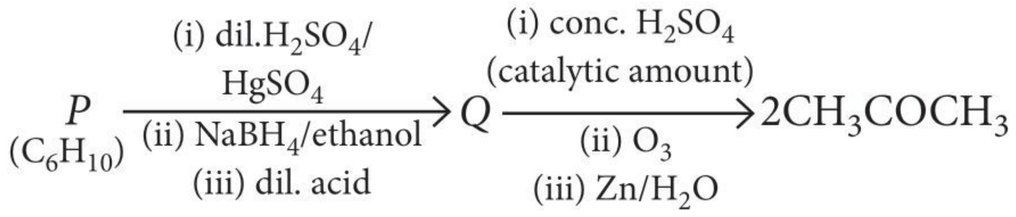


25. A metal '*X*' crystallises in a unit cell in which the radius of atom (r) is related to edge of unit cell (a) as $r = 0.3535\ a$. The total number of atoms present per unit cell is

26. How many of the following substances are more acidic than phenol?
o-Cresol, *m*-cresol, *p*-cresol, water, methyl alcohol, ethyl alcohol, 2,4-dimethylphenol, *p*-ethylphenol, dimethylcarbinol

Comprehension Type

An acyclic hydrocarbon *P*, having molecular formula C_6H_{10}, gave acetone as the only product through the following sequence of reactions, in which *Q* is an intermediate compound.



27. The structure of the compound *P* is

(a) $CH_3CH_2CH_2CH_2C \equiv CH$

(b) $CH_3CH_2C \equiv CCH_2CH_3$

(c) $(CH_3)_2CHC \equiv CCH_3$

(d) $(CH_3)_3CC \equiv CH$

28. The structure of the compound *Q* is

(a) $(CH_3)_2\underset{\displaystyle OH}{\underset{|}{C}}HCHCH_2CH_3$

(b) $(CH_3)_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$

(c) $(CH_3)_2CH\underset{\displaystyle OH}{\underset{|}{C}}HCH_2CH_3$

(d) $CH_3CH_2CH_2\underset{\displaystyle OH}{\underset{|}{C}}HCH_2CH_3$

Matrix Match Type

29. Match column-I with column-II and select the correct answer using the codes given below :

Column I	Column II
(A) $Hg^{2+}_{(aq)} + I^{-}_{(aq)} \rightarrow$	(p) Yellow precipitate
(B) $Cu^{2+}_{(aq)} + [Fe(CN)_6]^{4-}_{(aq)} \rightarrow$	(q) Brown precipitate
(C) $Mg^{2+}_{(aq)} + NH_{3(aq)} + HPO^{2-}_{4(aq)} \rightarrow$	(r) White precipitate
(D) $Pb^{2+}_{(aq)} + CrO^{2-}_{4(aq)} \rightarrow$	(s) Red precipitate

	A	B	C	D
(a)	s	q	r	p
(b)	p	r	s	q
(c)	r	s	q	p
(d)	q	p	r	s

30. Match column-I with column-II and select the correct answer using the codes given below :

Column I (Equiv. conductance at infinite dilution)	Column II (Formula)
(A) 229	(p) $[Pt(NH_3)_5Cl]Cl_3$
(B) 97	(q) $[Pt(NH_3)_3Cl_3]Cl$
(C) 404	(r) $[Pt(NH_3)_4Cl_2]Cl_2$
(D) 523	(s) $[Pt(NH_3)_6]Cl_4$

	A	B	C	D
(a)	r	p	q	s
(b)	p	r	s	q
(c)	p	s	r	q
(d)	r	q	p	s

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SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

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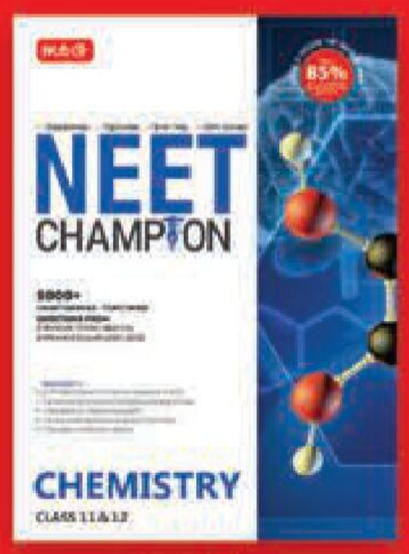

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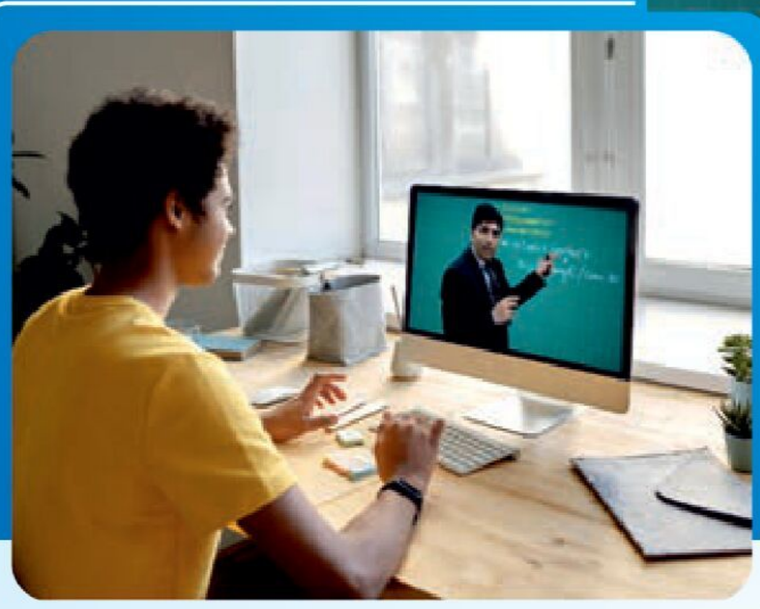

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